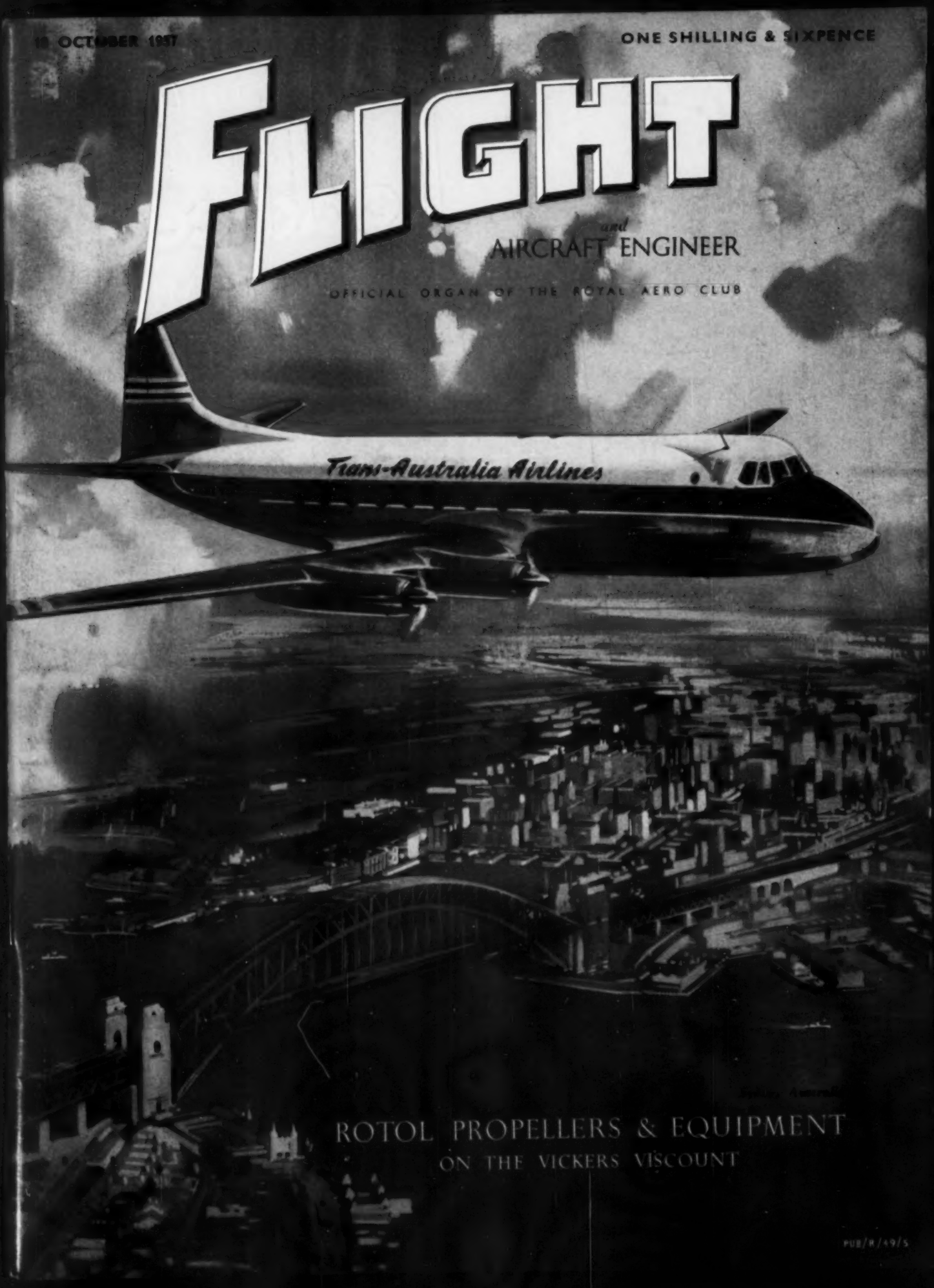
18 OCTOBER 1957

ONE SHILLING & SIXPENCE

FLIGHT

and AIRCRAFT ENGINEER

OFFICIAL ORGAN OF THE ROYAL AERO CLUB



ROTOL PROPELLERS & EQUIPMENT
ON THE VICKERS VISCOUNT

PUB/R/59/5

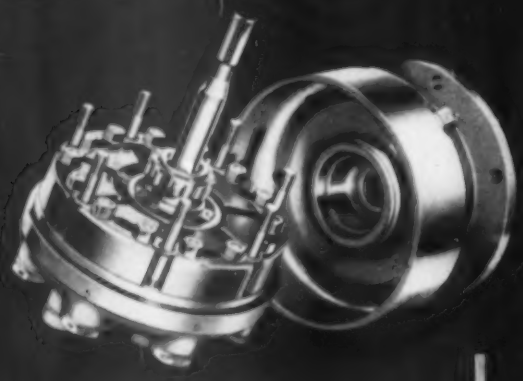
More hours in the air with Lockheed

ALL-BRITISH

REGD. TRADE MARK

HYDRAULIC PUMPS

Standardized on all these aircraft



Blackburn 'Beverley'

Auster 'Agricola'

Vickers 'Vanguard'

Handley Page 'Herald'

Aviation Traders 'Accountant'

Vickers 'Viking' and 'Viscount'

Sud Est 'Caravelle'

Prestwick 'Pioneer' & 'Twin Pioneer'

D.H. 'Comets' 2, 2E, 3 and 4

A.W. 'Freighter coach'

Period between overhauls proposed by B.O.A.C. for Lockheed hydraulic pumps on the 'Comet' 2E and all marks of the 'Comet' 4

5000 hours

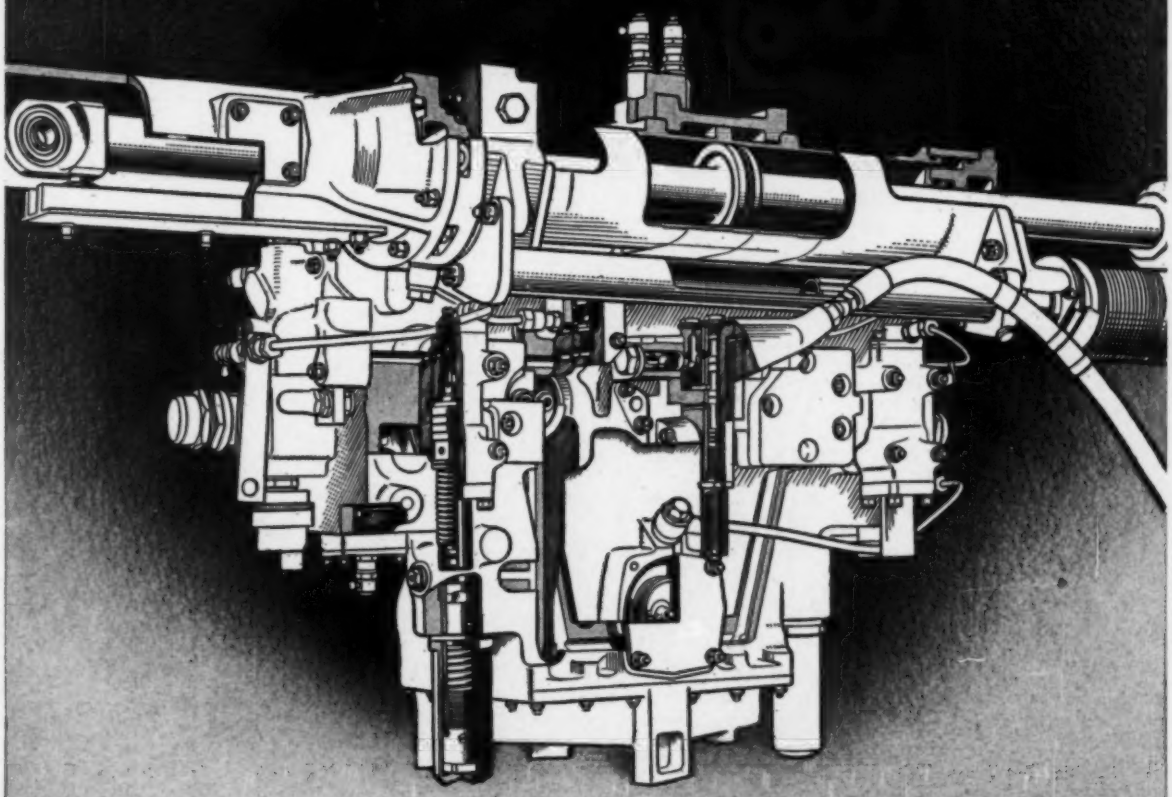
A.R.B. approved overhaul period for Lockheed hydraulic pumps on the Vickers 'Viscount'

6000 hours

AUTOMOTIVE PRODUCTS COMPANY LIMITED

LEAMINGTON SPA, WARWICKSHIRE, ENGLAND

Power Control



Increasing numbers of modern aircraft incorporate Boulton Paul powered flying controls in their design. Why is this? Because Boulton Paul Power Controls are sensitive, accurate, stable, reliable and safe.

BPA

BOULTON PAUL AIRCRAFT LTD.

WOLVERHAMPTON, ENGLAND

P.C. 20

Titanine Aircraft Finishes are used for the internal protection of the

VICKERS VISCOUNT

Technically the Viscount has proved a superb achievement and in addition is making a striking contribution to Britain's export economy. The aircraft illustrated is a Viscount of K.L.M. Royal Dutch Airlines, one of the first overseas deliveries of the 800 Series.

TITANINE AIRCRAFT FINISHES

TITANINE LIMITED, COLINDALE, LONDON, N.W.9. Telephone: Colindale 8123 (6 lines)

FACTORIES: LONDON, SURREY, SCOTLAND. ASSOCIATED COMPANIES: U.S.A. & HOLLAND.

ON DUTY....

NATO—
now seven years old—
is seven years stronger;
and the free world
is seven years safer.
REPUBLIC's Thundercraft
are ever on duty with NATO,
safeguarding peace—
through strength.

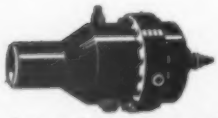
25 YEARS

REPUBLIC-AVIATION

FARMINGDALE, NEW YORK, U.S.A.

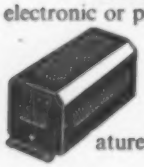
Designers and Builders of the Incomparable **THUNDER-CRAFT**

CABIN AIR CONDITIONING . . .

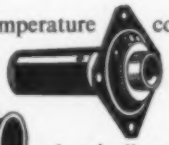


Cabin air conditioning system components including mass flow and flow rate controllers

electronic or pneumatically-operated temperature controllers



humidity controllers



duct and cabin temperature sensing units

electrically or pneumatically actuated gate or butterfly valves and thermostatic switches have been designed and developed for use in many present-day aircraft, military and civil, to meet the special features demanded by each installation.

CABIN AIR CONDITIONING CONTROL

ANTI-ICING CONTROL

FUEL TANK PRESSURISATION

HOT AIR AND GAS VALVES

ELECTRO-MAGNETIC VALVES

TIME SWITCHES

PRESSURE SWITCHES

PRESSURE REGULATORS

POTENTIOMETERS, ACCELEROMETERS AND PRESSURE TRANSDUCERS

Teddington CONTROLS

REGD TRADE MARK

TEDDINGTON AIRCRAFT CONTROLS LTD.

MERTHYR TYDFIL, SOUTH WALES. Telephone: Merthyr Tydfil 666

LONDON OFFICE: COLNBROOK BY-PASS, WEST DRAYTON, MIDDLESEX. *Telephone: Colnbrook 2202/3/4*

TAC 168

Complex INSULATION *problems solved!*

with the LIGHTWEIGHT HIGH TEMPERATURE INSULATION BLANKET *for* JET ENGINES, TAIL PIPES *and* RELATED ACCESSORIES *up to* 1,000° *centigrade.*

- MAXIMUM INSULATION MINIMUM WEIGHT
- INCREASED SAFETY AND OPERATIONAL EFFICENCY
- FLAT COVERING TO WRAP ROUND CURVED SURFACES
- PRE-FORMED FOR DOUBLE CURVATURES
- TAILOR MADE TO COMPLEX SHAPES AND EXACTING REQUIREMENTS

Illustration of a B·A·P *Insulation Blanket, assembled and exploded, showing a typical application to a complex shape.*

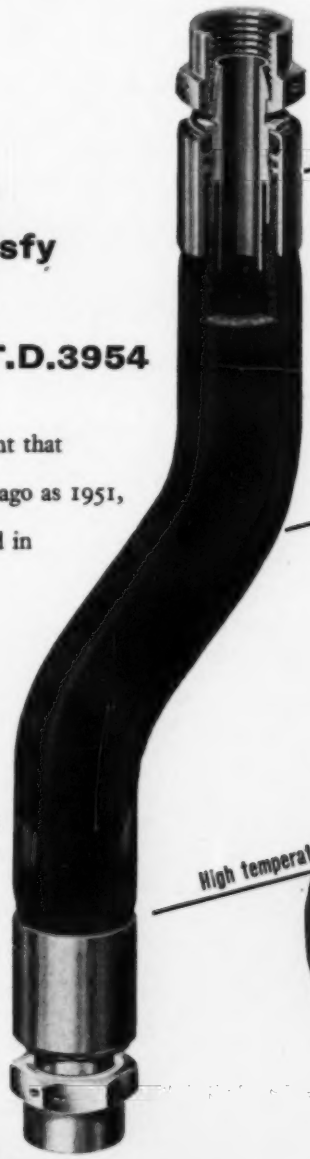
BURNLEY AIRCRAFT PRODUCTS LIMITED

FULLEDGE WORKS · BURNLEY · LANCASHIRE · ENGLAND

Tel: 3121/2 and 3203 Burnley (3 Lines) *Grams "AIRCRAFT" Burnley*

REPAIR DIVISION · BRITANNIA WORKS · QUEENSGATE · BURNLEY · Tel. 4102

Silvoflex Type 200



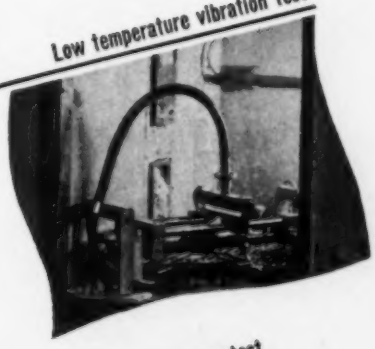
The first flexible Hose Unit to satisfy Air Ministry Specification D.T.D.3954

This specification is so stringent that although it was issued as long ago as 1951, no manufacturer has succeeded in satisfying it until now.

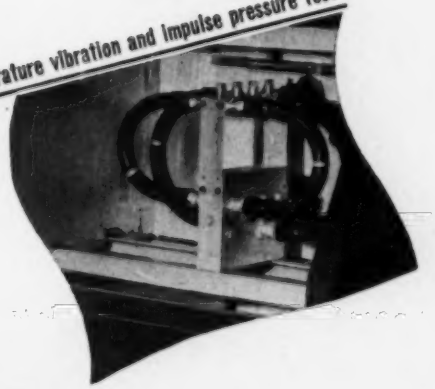
These are some of the many tests, the equipment and techniques for which have been developed by Palmer Engineers.

Fire resistance test

Low temperature vibration test



High temperature vibration and impulse pressure test

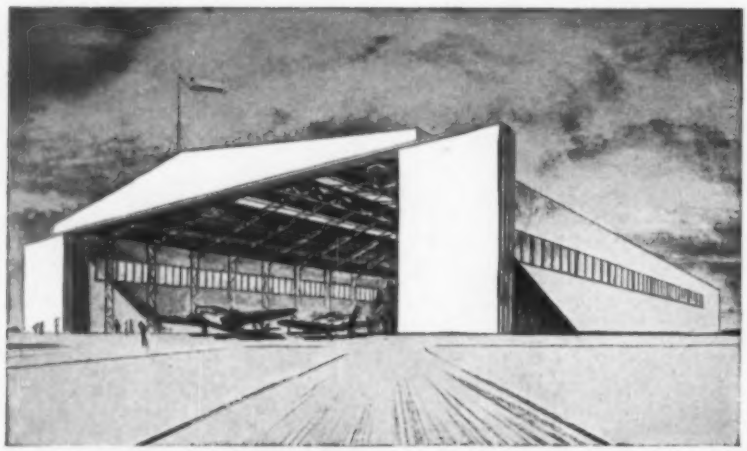


Palmer

The Palmer Tyre Limited PENFOLD ST. EDGWARE RD. LONDON N.W.8

AERO COMPONENTS · RAMS · VALVES · SILVOFLEX HOSE · X-RAY INSPECTION SERVICE

SI357



Standard designs
200′ 0″ to 30′ 0″ spans

STEEL ECONOMY

SPACE ECONOMY

TROPICAL SHEDS & HOUSES
GODOWNS · BARRACKS · OFFICES, ETC.

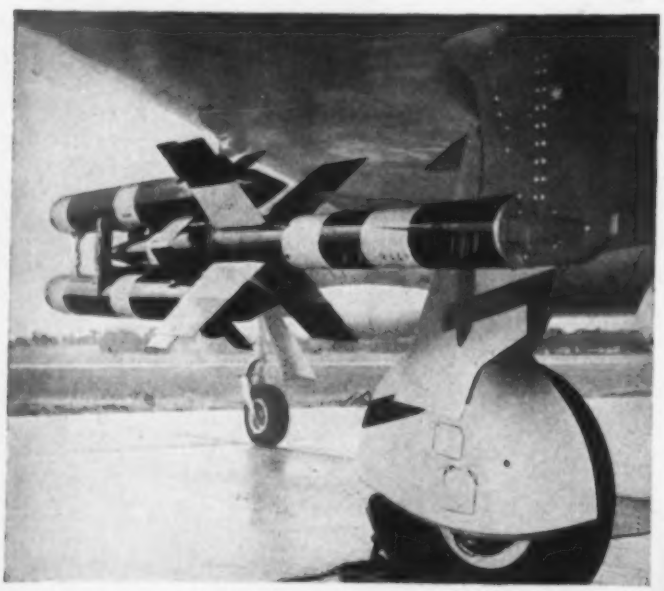
We supply and erect in any part of the world.

GENERAL UTILITY **STEEL BUILDINGS** AND **HANGARS**

FOR HIRE. Erection masts 30ft. to 180ft. high. Cranes and lifting tackle.

BELLMAN HANGARS
LIMITED

HUBART HOUSE, GROSVENOR PLACE, LONDON, S.W.1 *Tel:* **SLOANE 5258** *Cables: Unitstruct, Sowest*



VENNER
Silver-Zinc
G.W. Accumulators

Used in the development of the Fairey 'Fireflash' and extensively for guided missiles.

- **Small measurements.**
- **High power to weight ratio.**
- **High rates of discharge.**
- **Constancy of output.**

Type SZ6 Accumulator.

Type SZ6|12 Accumulator.

For full particulars write to Dept. F|A.

VENNER ACCUMULATORS
LIMITED

KINGSTON BY-PASS, NEW MALDEN, SURREY. Telephone: MALden 2442

Associated Companies : Venner Electronics Limited. Venner Limited

FERRANTI

FIRE CONTROL EQUIPMENT AND PRECISION COMPONENTS

In their factories and laboratories in Scotland, Ferranti Ltd. have obtained considerable experience of the design and manufacture of Fire Control and Radar Equipment for front line aircraft. A radar system for the English Electric P1B Fighter is in production.

As a further service to the Aircraft Industry, Ferranti Ltd. undertake the design and manufacture of Precision Components including Electronic Valves, Gyroscopes, Potentiometers and Transformers.

FERRANTI LTD · FERRY ROAD · EDINBURGH 5

EDINBURGH

ES/T40

NEW G.E.C. HEATED CONTAINER

NOW HAS FIBRE GLASS OUTER CASE . . .

By fitting a fibre glass outer case, and also sunken pins, the G.E.C. have made this already highly successful heated container (HO3373F) more efficient than ever. The advantages of the new model are detailed below.

Advantages	Lighter weight. Greater strength. Improved performance.
Additional Feature	The outer case can now be supplied in any colour to suit the individual requirements of the airline operators.
Overall Dimensions	Height 16" (40.64 cm.) Width 8" (20.32 cm.) Depth 8" (20.32 cm.) *1 lb. 5 ozs. lighter than existing stainless steel model.*

More than 50 airlines using 25 types of aircraft use G.E.C. aircraft galley equipment

G.E.C. ELECTRICAL EQUIPMENT FOR AVIATION

In the Air—On the Ground

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON W.C.2

HONG KONG AIRCRAFT ENGINEERING COMPANY, LIMITED

numbers among its customers:

Aigle Azur Extreme Orient
Air India International
Air Vietnam
de Bataafsche Petroleum Maatschappij N.V.
Brunei Shell Petroleum Co., Ltd.
Canadian Pacific Airlines
Civil Air Transport
Garuda Indonesian Airways N.V.
Korean National Airlines
Malayan Airways Limited
Nederlandsche Nieuw Guinea Petroleum Maatschappij
Philippine Air Lines, Inc.
Royal Air Cambodge
Standard-Vacuum Petroleum Maatschappij
Swissair
Thai Airways Company, Ltd.
Air France
Air Laos
Bahamas Helicopters, Ltd.
British Overseas Airways Corporation
Caltex Pacific Petroleum Maatschappij
Cathay Pacific Airways
Federation Air Services
Hong Kong Airways
Macau Airtransport Co. (HK), Ltd.
Mandated Airlines Limited (New Guinea)
Northwest Orient Airlines
Qantas Empire Airways
Scandinavian Airlines System
Tasman Empire Airways, Ltd.
Union of Burma Airways Board
World Wide Air Services

also

Royal Air Force
United States Air Force
United States Navy
United States Marine Corps

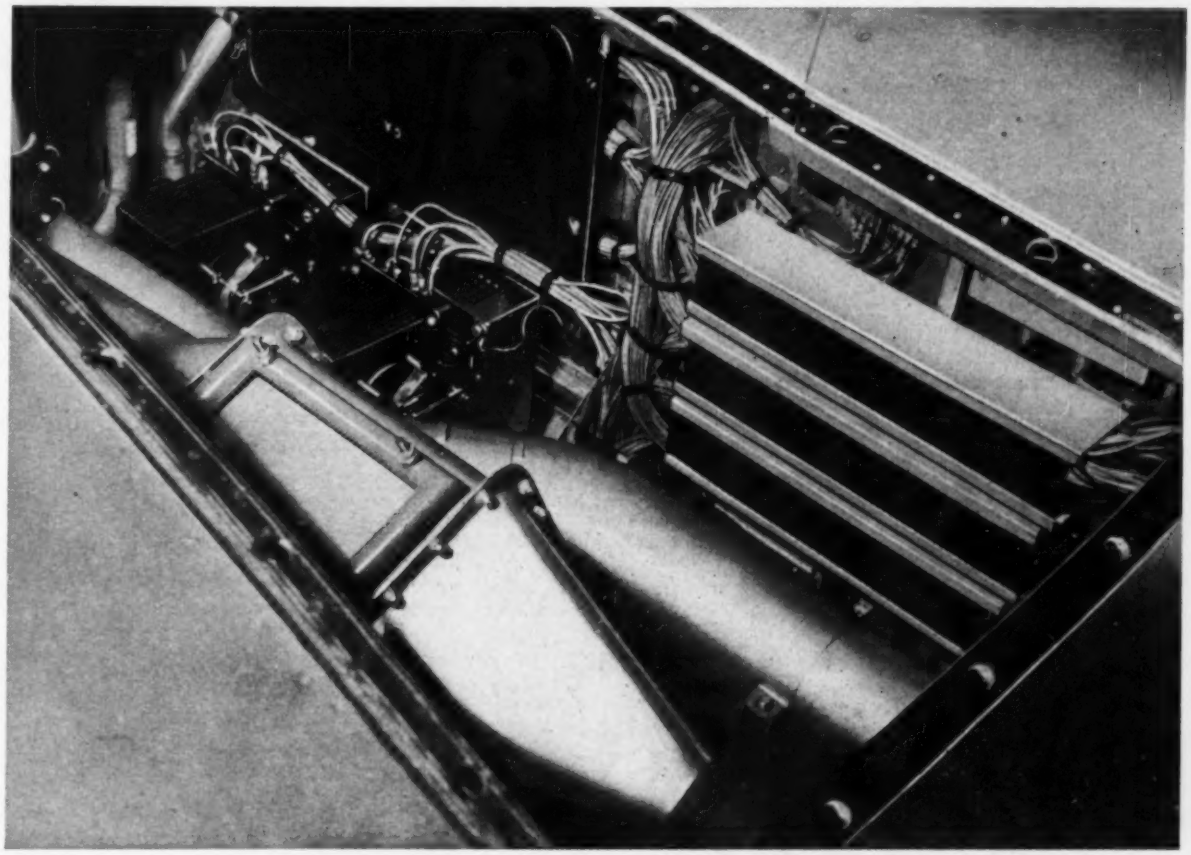
Inquiries for

Airframe, engine, instrument, accessory overhauls, repairs, modifications to:

HONG KONG AIRCRAFT ENGINEERING COMPANY, LIMITED

KAI TAK AIRPORT, HONG KONG **Cable address: AIRENG**

'FLUON' *increases production in the Aircraft Industry-No.1*



Insulated cables made for the de Havilland Comet by British Insulated Callender's Cables Ltd.

'Fluon' cables in the de Havilland Comet

TODAY, MORE THAN EVER, cables used in aircraft must be capable of standing up to the constantly increasing strains caused by ever greater speeds and altitudes. They must remain unaffected by extremes of temperature, have good chemical resistance as well as exceptional insulating and dielectric properties.

To meet these problems cables in the de Havilland Comet are made from tough, flexible 'Fluon' polytetrafluoroethylene, the plastics material with the unique range of properties. 'Fluon' p.t.f.e. is now available in coagulated dispersion form. This type of polymer has been specially developed for the extrusion of thin wall tubes and for wire covering. Coagulated dispersion polymer extrusions are remarkable for their excellent flexural fatigue behaviour.

'Fluon' is also without equal as a reinforced flexible hose material. The aircraft industry has been quick to recognise its potentialities in the handling of fuels, lubricants and hydraulic fluids. 'Fluon' is unaffected by all known corrosives except molten alkali metals and fluorine compounds. And it has a working temperature range up to 250°C. and down to at least −80°C.

'Fluon' has a non-stick surface and a very low coefficient of friction. Its shelf life is indefinite and its performance consistent and reliable.

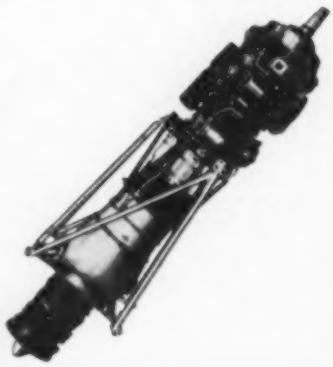
'FLUON'

'Fluon' is the registered trade mark for the polytetrafluoroethylene manufactured by I.C.I.

ICI IMPERIAL CHEMICAL INDUSTRIES LIMITED · LONDON · S.W.1

PF.30

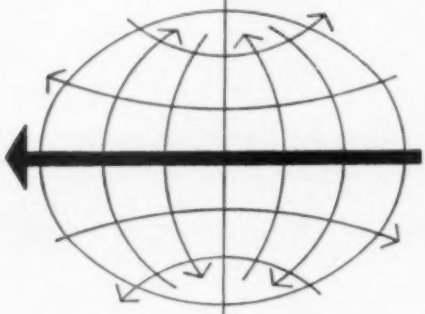
ELAND (for fixed wing aircraft) propeller-turbine engine for new airliners and conversion of piston engine airliners to propeller-turbine power. Chosen for the Hamburger Flugzeugbau C209 and the Convair 340.



ELAND (for helicopters) specially designed for the Fairey Rotodyne, is basically the standard Eland with an auxiliary compressor mounted at the rear. A further design with a rear gear box is installed in the Westland Westminster helicopter.

ORYX turbo gas generator designed for helicopters where the rotor is propelled by jet reaction at the blade tips.

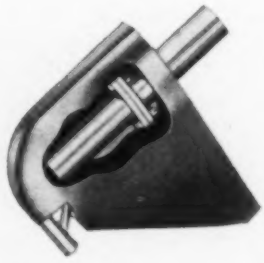
NAPIER AERO ENGINES



for the world

SCORPION an aircraft rocket engine which provides a source of extra power at high altitude. Designed for sustained firing and long operational life.

GAZELLE free turbine engine designed primarily for helicopter propulsion. Chosen for the Westland Wessex and the Bristol 192. Can be adapted for fixed-wing applications.



TIP THRUST UNITS for helicopters restore performance lost through heat, humidity and height. In operation in the Saunders Roe Skeeter.

D. NAPIER & SON LIMITED—LONDON, W.3. Member of the ENGLISH ELECTRIC Aviation Group

CRC 8.36

FIRST AERONAUTICAL WEEKLY IN THE WORLD FOUNDED 1909

FLIGHT
and
AIRCRAFT ENGINEER

No 2543 Vol 72 FRIDAY 18 OCTOBER 1957

Editor
MAURICE A. SMITH D.F.C. AND BAR

Associate Editor
H. F. KING M.B.E.

Technical Editor
W. T. GUNSTON

Production Editor
ROY CASEY

Iliffe and Sons Ltd.
Dorset House
Stamford Street
London, S.E.1
Telephone · Waterloo 3333

BRANCH OFFICES

Coventry
8-10 Corporation Street
Telephone · Coventry 5210

Birmingham
King Edward House, New Street, 2
Telephone · Midland 7191 (7 lines)

Manchester
260 Deansgate, 2
Telephone · Blackfriars 4412 (3 lines)
Deansgate 3595 (2 lines)

Glasgow
26B Renfield Street, C.2
Telephone · Central 1265 (2 lines)

Toronto, Ontario
Thomas Skinner of Canada, Ltd.
67 Yonge Street, 1
Telephone · Empire 6-0873

New York, N.Y.
Thomas Skinner and Co. (Publishers), Ltd.
111 Broadway, 6
Telephone · Digby 9-1197

ANNUAL SUBSCRIPTION
Home £4 15s 0d, overseas £5 0s 0d.
Canada and U.S.A. $15.00.

Entered as second-class matter at Post Office, New York, N.Y.

In this issue

604 Arrow Mk 1
607 VTOL Design Problems
609 Vibration Research
611 A New Realm of Flight
615 Operation Longshot
616 Process of Perfection
618 No. 5 Squadron

Signpost in Space

THE underlying significance of the Soviet satellite is neither scientific nor military. It is true that the tiny orbiting sphere has set the whole world marvelling at the technical prowess of those who built and launched it. True also that the rocket which first projected it towards space may be related to some fearful weapon of terrestrial bombardment. But weightier by far is another truth: that many people have suddenly, and almost for the first time, found themselves thinking for themselves—and thinking thoughts so deep as to cut clean through the clinker of tendentious "comment." No misrepresentation could extinguish the speck of light; nor could the brave little "bleep" be drowned by the clamour for official inquiries and crash programmes, or for denunciation of Russian perfidy. People everywhere became suddenly aware that something very wonderful had happened: that beyond the fringes of the world a clear sign was pointing out towards discovery and adventure without limit—towards a new fraternity of science. There and then the bluster of the politicians seemed futile and the Russians somehow bigger in stature for the calm and candour of their declarations to the world.

The good that their little sphere has accomplished, and the permanence of that good, cannot yet be measured. Some people have been merely frightened. Some have been jolted into acute discomfiture. Others still have been given new hope for a world wherein men of science, allied with statesmen deserving of the name, will be allowed to show the way out of a morass of miseries and fears.

To these men new power must bring not arrogance but humility. From this week forward we hope increasingly to chronicle their efforts towards new worlds—and a new world.

The New Liberalism

AMONG the changes already coming about in the conduct of the world's affairs are some very significant ones in the field of transport. Attention was drawn to the fact last Monday by Sir Reginald Wilson, a member of the British Transport Commission, in his presidential address before the Institute of Transport. "It is clear, I think," he said, "that the separation to which the various branches of transport were once exhorted with almost religious fervour is now on the wane. In the sphere of ownership we see liberalising tendencies like the participation of shipowners in air transport. Railways become interested in pipe-lines . . . ships are owned by road hauliers . . ." In administration, he remarked, there has been an amalgamation of the Government departments that regulate transport affairs.

In politics there are public demands that all forms of transport shall work together to cure congestion and prevent wasteful duplication. And in commerce there is a continually closer inter-working. In sum, all the means of transport are increasingly mixed together, and must be used to aid each other as necessary. More than this—it is no longer a prime objective that the technical means of transport shall compete with each other as such. Competition more and more depends on offering the best *combination* of means for any given stream of traffic. Aircraft already provide the long haul for bus traffic, and the container van can be carried by air as well as by sea or rail.

So the future of transport, like that of the world itself, seems full of opportunity and challenge. Even the difficulties are similar. As Sir Reginald puts it, "If we are not to have a Tower of Babel, the operators involved must understand one another."

So here is a chance for statesmen within our own industry of air transport—and for merchant venturers of the calibre of Silver City's "Taffy" Powell (whose imminent retirement, for reasons of health, we hope will be neither permanent nor protracted). For we can be thankful that the new liberalism will still afford scope for the prospector as well as for the speculator.

FROM ALL QUARTERS

SR.177 is the makers' designation of the Saunders-Roe all-weather intercepter shown here as a model. Prototypes are being built for the Royal Navy under contract from the Ministry of Supply and the power units are a de Havilland Spectre rocket and a Gyron Junior turbojet (news item below). Although not evident here, the intake is of wedge form.

SR.177 Development Contract

A DEVELOPMENT contract has been placed by the Ministry of Supply with Saunders-Roe, Ltd., for a naval carrier-based mixed-power all-weather intercepter which the company has for some time been developing. Powered by a de Havilland Gyron Junior turbojet and a Spectre rocket, it is designated the SR.177. The aircraft—"a number of which," the official announcement states, "are being built"—is a direct development of the SR.53, which first flew in May this year and was demonstrated at the S.B.A.C. show in September.

Announcing the SR.177 in London last Friday, the company stated that it would carry more operational equipment than, and have a performance "considerably superior to," the SR.53. It would be equipped with A.I. radar and carry Firestreak guided weapons (one at each wing-tip).

Mr. Maurice Brennan, chief designer of Saunders-Roe, said the contract had been placed "to satisfy a Naval Staff requirement"; no decision had yet been made about a production order, nor could he say how many were being built. There was "intense German interest" in the new aircraft.

Mr. Brennan said that the SR.177 would be capable of interceptions "very much farther out" than a ground-to-air missile; and he added that in its conception the company considered they were "running along on the lines of the Defence White Paper."

Two short films were shown on the occasion of the announcement, one recording the first flight of the SR.53 and the other (taken by a ciné camera fitted to the starboard wing of an SR.53) giving a vivid impression of the Spectre's diamond shock-waves during flight.

A model, illustrated above, reveals several features of uncommon technical interest. Although the SR.177 proclaims its direct descent from the SR.53 it is clearly going to be larger and heavier, and its interior must make provision for a great variety of operational weapon-system equipment not needed by the SR.53. The resulting "slab-sided" body shape is not aerodynamically inefficient, and—as in the case of the English Electric P.1—lends itself well to the achievement of optimum axial area-distribution for minimum transonic drag. The SR.177 wing volume is, in any case, relatively small, and can to some extent be ignored (as with the F-104).

It is well known that the Viper turbojet of the SR.53 is rather smaller than the optimum, and the Gyron Junior for the 177 is more than four times as powerful. Clearly, the final 177 will have the most powerful type of Gyron Junior, complete with an afterburner and con-di variable nozzle. It could also be deduced that it will conform to de Havilland's concept of an "all-H.T.P." aeroplane, in which this medium is used for the rocket motor, for starting the turbojet and for driving an emergency accessory power unit. The latter would also be needed to maintain essential services at altitudes over 90,000ft, where the air would certainly be too thin to keep the turbojet alight.

It will be noted that the powerplants of the SR.177 are mounted differently from those of the SR.53. The turbojet is now the low-mounted partner, doubtless fed from a supersonic wedge-type intake under the fore-body (probably with a variable wedge-angle). Other features include what is probably a retractable flight-refuelling probe (kerosine only) in the port-side; a revised cockpit canopy and knife-edge windscreen; and repositioned nose undercarriage and air brakes. It is also worth noting that the missiles carried on the SR.177 model differ widely from the Firestreak as already revealed, though this fact may have little or no significance.

Polar Rescue Plan

A PROPOSAL to drop an air rescue expedition by parachute at the North Pole next May, as the forerunner to a permanent international air rescue team for the Polar ice-cap, was announced in London last week. The proposal has been made by the Council of Management of the Polar Air Rescue Expedition of 1958, the initiative for which has come largely from Mr. W. Stanley Moss, the author.

With Marshal of the R.A.F. Lord Tedder, who is chairman of the council, Mr. Moss explained that with the increasing number of aircraft now crossing the Pole, some sort of permanent international rescue organization seemed to be necessary. An advance party of about eight men, using dogs—dropped in specially designed plastic containers—and sledges, would attempt a 600-mile march from the Pole to North Greenland, where the expedition's base would probably be located.

Sir Thomas White

WE regret to record that G/C. the Hon. Sir Thomas White, K.B.E., D.F.C., V.D., A.M.I.Ae.E., F.R.G.S., formerly High Commissioner for Australia in London, died suddenly at his home near Melbourne last Sunday at the age of 69.

Sir Thomas had close and practical associations with aviation.

ROTOR TUG: A Whirlwind of No. 705 Sqn., R.N.A.S. Lee-on-Solent, piloted by Lt-Cdr. G. G. R. Miller, towed the R.N. coastal minesweeper H.M.S. "Gavinton" (450 tons displacement) for about two miles at a speed of approximately five knots during an experiment in Sandown Bay on October 10. This was the first time a helicopter had been used in this country to tow a vessel of such a size.

He started flying in 1914 and served with the first overseas unit of the Australian Flying Corps, winning the D.F.C. and being twice mentioned in dispatches. He founded the Australian Aero Club in 1914, and between 1923 and 1927 was successively its vice-president and federal president.

During the Second World War, Sir Thomas served with the R.A.A.F., his first appointment (in 1940) being as C.O. of No. 1 Initial Training School. Later, in this country, he became responsible in 1942 for R.A.A.F. liaison at R.A.F. Flying Training Command and in 1943 commanded Brighton R.A.F. station.

After the war, one of his Australian Government appointments was as Minister for Air and Civil Aviation, from 1949 to 1951.

New Bristol Aircraft Chairman

AS we close for press we learn that Rear Admiral Sir Matthew Slattery, C.B., chairman and managing director of Short Brothers and Harland, Ltd., has been elected a director of the Bristol Aeroplane Co., Ltd., and has been appointed chairman of Bristol Aircraft, Ltd., in succession to Mr. C. F. Uwins, who becomes a deputy chairman of the parent company. One objective of Sir Matthew's appointment will be to further co-operation between Bristol Aircraft and Short Bros., in which Bristol have a shareholding.

Mediterranean Command

AS Admiral Sir Ralph A. B. Edwards has had to relinquish his Mediterranean Command through illness, he is succeeded as C-in-C. (and in the NATO appointment of C-in-C. Allied Forces Mediterranean) by Admiral Sir Charles E. Lambe. Admiral Lambe's previous appointments (he is succeeded as Second Sea Lord by Rear Admiral D. E. Holland-Martin) have included those of Flag Officer Flying Training and Flag Officer (Air) Home. He qualified as a free-balloon pilot in 1918 and in 1929 gained his civil "A" licence.

E.P.9 Progress

A PAIR of Edgar Percival E.P.9s for Skyspread Pty., Ltd., were accepted from the makers last week and were to begin their flight out to Australia this week. Resplendent in bright red paint finish and bearing brightly painted Skyspread motifs, the machines are being flown out *via* Italy, the Middle East, India and Singapore by "Titus" Oates and "Wac" Whiteman. They hope to cover some 950 miles each day in two flights, carrying the 33 cu ft hopper empty and a 56 gall extra fuel tank in the cabin behind it. Two other E.P.9s, for Superspread Aviation, Ltd., have now completed a similar delivery flight.

Meanwhile, other E.P.s are in service or shortly due in North Africa, Germany, Canada, Australia, New Zealand, Viet Nam, and Algeria; and a demonstrator is to go to Finland during the next few days for inspection by the Finnish armed services and civilian agencies. A very simple structural modification, consisting principally of a gusset plate and supplied in kit form to operators in the field, has permitted an increase of 150 lb in the normal gross weight to 3,700 lb. Rot-proof seat harness, and an extra window in the roof on the right-hand side have now been made standard for agricultural flying; and larger tyres may be fitted to reduce tyre wear-and-tear when operating from really rough desert ground.

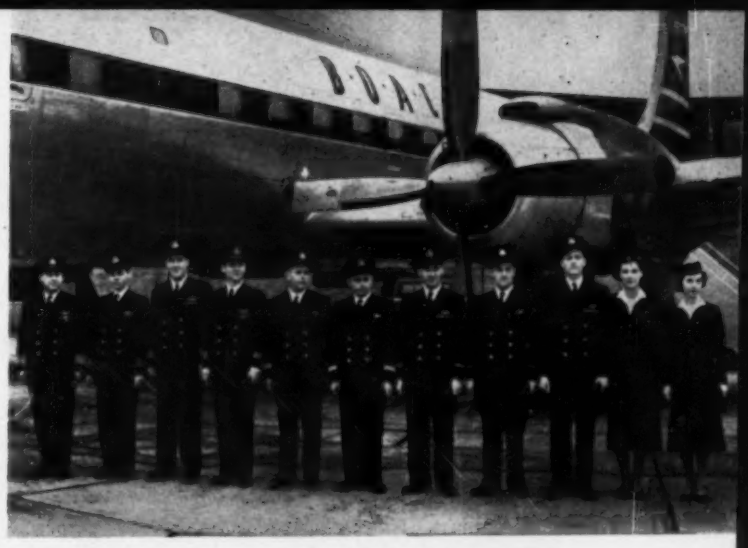
As an example of loads carried, a complete Napier Gazelle engine has been accommodated comfortably in the cabin, and transporting an Orpheus may soon be tried. Three rotor-blades and the powerplant of a Bell or Hiller helicopter can be carried. As an ambulance, the E.P.9 can take two stretchers and an attendant, with the great advantage that the cabin is high enough to allow blood transfusions to be continued in flight.

Worldwide Helicopters, Ltd., are operating three E.P.9s in Libya and have sent back glowing reports of the aircraft. They have been nick-named "Flying Florence Nightingales" for their casualty evacuation work and have operated regularly from completely unprepared desert surfaces.

Thunderflash on the Loose

FOLLOWING complete hydraulic failure in his Thunderflash, Sgt. W. G. Evers of the Royal Netherlands Air Force was left only with his electric tailplane-control system. He was ordered by radio to bale out and on landing safely, saw his aircraft was continuing to fly. It remained airborne for an hour and a half, making slow left and right turns. A Canberra was sent up from Laarbruch to shoot it down over open country, but the Thunderflash kept close to populated areas and finally glided down through cloud when its fuel ran out.

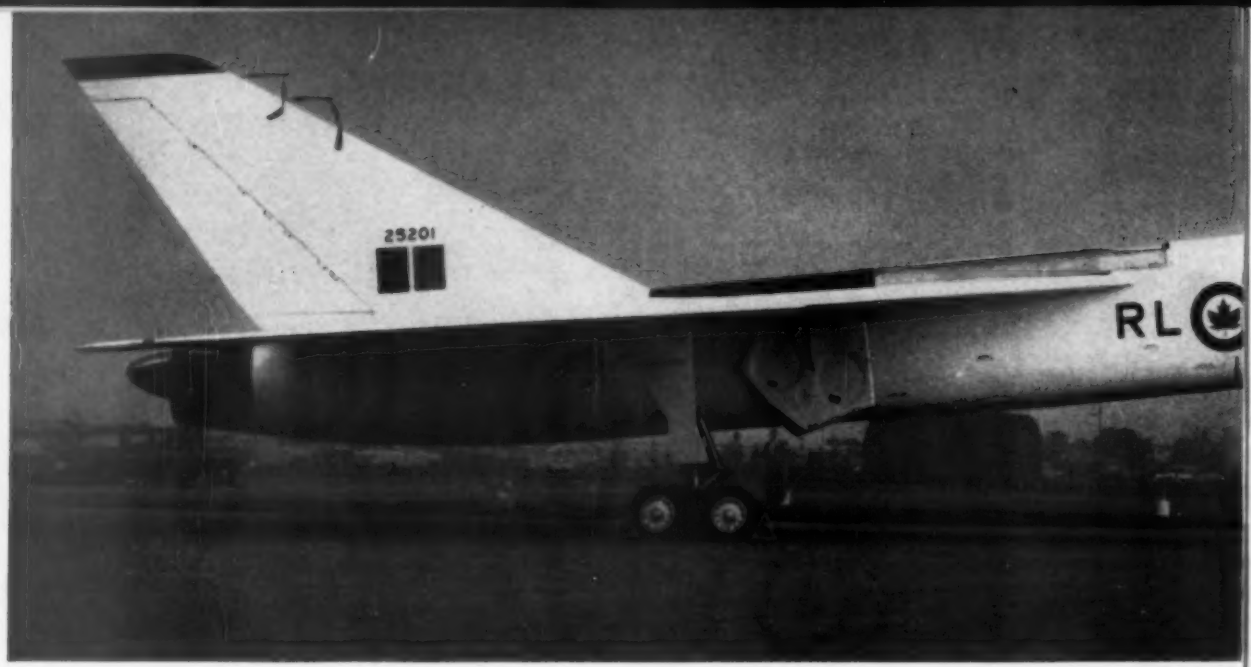
Incredibly enough, the wayward, self-willed Thunderflash then made an excellent landing, sustaining only relatively minor and repairable damage, near Venray on the Dutch-German frontier. It is not clear from reports whether or not the undercarriage had been lowered before Sgt. Evers ejected, but the landing gear is reported to have suffered damage, together with the wingtips.

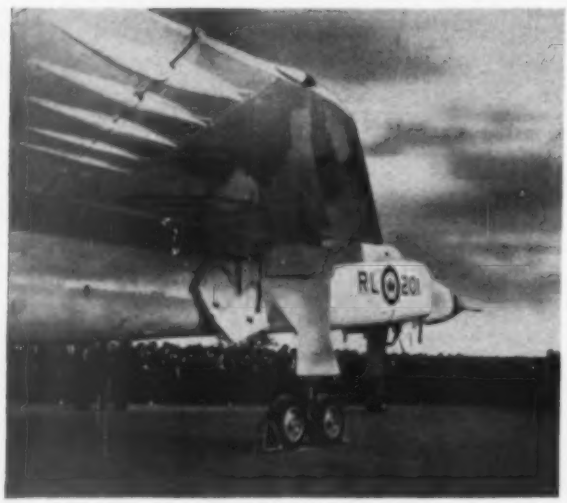


THE ROYAL TOUR: Members of the crew of the B.O.A.C. DC-7C which flew H.M. the Queen and the Duke of Edinburgh to Canada for the Royal Tour on October 12: Left to right, Capt. Gordon Store; co-pilot, Capt. E. C. Miles; 3rd pilot, 1st/Off. C. A. Morroe; 4th pilot, 1st/Off. I. R. Phillips; Nav/Off. G. H. Brown; Eng/Off. R. Smith; Chief Steward H. H. Craik; 2nd Steward F. H. Ross; 3rd Steward L. J. Miller; 1st Stewardess Faith Sisman; 2nd Stewardess Velma Brown.

WEIGHING IN: Routine operation on a production Blackburn Beverley. The aircraft is first weighed in the horizontal position and then 10 deg nose-up in order to establish the vertical position of the c.g. The weight is recorded on pressure pads under the three oleos of the undercarriage when the hydraulic jacks are relieved of all weight.

CHECKING OUT from the Edgar Percival factory at Stapleford Tawney, Essex, are these two E.P.9s for delivery to Skyspread in Australia. They are painted red, with yellow motif and white registration. "Titus" Oates and "Wac" Whiteman are to fly them from Britain, via the Middle East and Singapore, to the operator, as noted in a paragraph on this page.



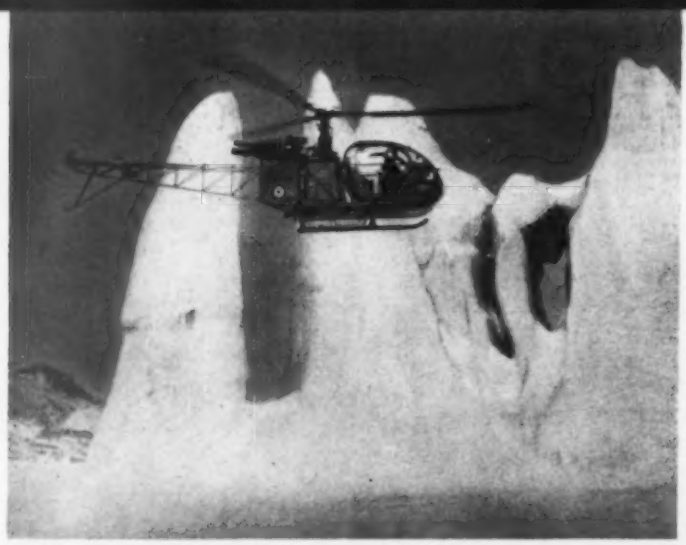


Arrow Mk 1

Avro's Mighty Fighter

THE first Arrow Mk 1 all-weather fighter, the salient characteristics of which are brought out in the three large pictures on these pages, was rolled out from the Avro Aircraft plant at Malton, Ontario, on October 4. This magnificent aeroplane was formally unveiled in the presence of "government, military, civic and industrial leaders," and was subjected to the closest scrutiny. A feature not evident in the large views, but seen to advantage on the left, is the series of aileron-jack fairings on each wing. The picture at upper right shows Sir Roy Dobson, chairman of the board of A. V. Roe Canada, Ltd. (left) chatting with the famous Canadian pioneer J. A. D. McCurdy, who flew the Silver Dart—Canada's first aeroplane—fifty years ago. On the right of the group is Crawford Gordon, president and general manager, A. V. Roe Canada, Ltd.

IN both military and technical senses the Arrow is a very remarkable achievement. It promises an exceedingly high performance combined with long range and capacity for an unprecedented load of electronic equipment and armament. The power units of the Mk 1 version are two Pratt and Whitney J75 turbojets with reheat, but the second mark of Arrow will have Orenda Iroquois, likewise, of course, with reheat. The span of the delta wing is 50ft; overall length is 77ft 9½in and height 21ft 3in. The first Arrow was completed in under thirty months from the first design release, and the man-hours-per-pound required for its production are claimed to have been about 80 per cent of those necessary for projects of similar size and complexity throughout the aviation industry in North America. The makers add: "It is now four years since the design started. This is considered better than average for the time required to design and build present-day high-performance aircraft." The present Arrow is said to be "on the threshold of the heat barrier" and studies are in hand to adapt the aircraft for "even higher speeds to pierce this barrier." A fighter of such all-round capability could doubtless be developed to serve as a potent strike aircraft.



GENTILLE ALOUETTE: In a fairyland of icebergs is this Sud Aviation Alouette II helicopter—a component of a recent reconnaissance mission to Greenland. The mission is a prelude to a forthcoming international expedition on an extensive scale.

HOME PURSUIT: A replica of a Fokker D.VII fighter of World War I (below) with its builder and pilot, Ed Brennan, a fireman of North Olmstead, Ohio. Only the engine (type unspecified) lacks authenticity.

HERE AND THERE

Dutch Aero Club Jubilee

TOMORROW, October 19, the Royal Netherlands Aero Club celebrates the 50th anniversary of its foundation. To mark the occasion, Prince Bernhard will formally open the new building in The Hague into which the club moved this summer.

English Electric, Australia

AN Australian subsidiary—the English Electric Co. of Australia Pty.—has been registered by the English Electric Co., Ltd. Until now the Australian company has operated as a branch of its U.K. parent.

M.o.S. Appointments

FORMERLY Head of the Supersonics Division, Aerodynamics Department, R.A.E., Farnborough, Mr. P. A. Hufton, M.Sc., has been appointed Head of the Aerodynamics Department at the R.A.E. Bedford. He is succeeded at Farnborough by Dr. D. Kuchemann, Dr. rer. nat., F.R.Ae.S.

H.P.—Bilinguist

WHEN Sir Frederick Handley Page, as Lord Lieutenant of Middlesex, gave a farewell dinner at Middlesex Guildhall to representatives of the Department of Seine-et-Oise who had been visiting London, he acted as interpreter. He gave his own speech in both English and French and translated that of M. Coquelle, who responded for the guests.

R.F.C. and R.N.A.S. Reunion

A GROUP of First World War pilots are planning a reunion in Toronto—provisionally fixed for March 31 and April 1 next year—and would be glad to hear from ex-R.F.C. or R.N.A.S. officers anywhere in the world who may be interested in attending. Details from A. F. MacDonald, de Havilland Aircraft of Canada, Ltd., Postal Station "L," Toronto, Ont.

Honour for A. E. Raymond

CHOSEN to receive the 1957 Daniel Guggenheim Medal "for notable achievements in the advancement of aeronautics" is Mr. Arthur E. Raymond, vice-president, engineering, of Douglas Aircraft. He is the 29th individual to receive this important honour, and the accompanying certificate when it is presented at the Honours Night dinner of the I.A.S. on January 28 will record his ". . . development of a long line of civil and military aircraft and . . . notable contributions to aeronautics in public service.

Fruitful

ANOTHER contract for banana-spraying by helicopter in Panama has been awarded to Fison-Airwork, Ltd., by the United Fruit Co. of Central America. Two Hiller 12Cs purchased by Fison-Airwork for this contract have arrived in Panama and operations are already under way.

Advance Information

MENTIONING a claim that America had produced a steel which would withstand the heat generated by flight at 2,700 m.p.h., Mr. W. J. Taylor, Parliamentary Secretary to the Ministry of Supply, said recently "What can be made in the U.S.A. can be made in Sheffield. The Ministry of Supply is engaged in research into all-steel aircraft; in fact, one is being made now." Mr. Taylor was addressing members of Sheffield Publicity Club.

Proximity Indicator Trials

FOUR of the major U.S. airlines are to evaluate an infra-red proximity-warning device during the coming months. Made by Aerojet-General Corporation, it gives hemispherical-coverage and includes I.F. detectors fitted above and below the fuselage. Total weight is 30 lb and power demand 100 W. Trials in four different types of aircraft are expected to show whether or not the warning range of two miles previously specified is sufficient to meet current requirements.

G-AXXX?

A D.H. DOVE is now being used by Ind Coope and Allsop, the brewers, as an executive aircraft. Based at Burnaston Airfield, it replaces the Rapide which they formerly employed.

Missile Indoctrination

TROOPS of the new West Germany Army are to receive training in the U.S. next year at Fort Sill, Okla, in the use of Honest John, Matador and Nike missiles.

Vortex Thermometer

TO give pilots of high-speed aircraft direct and accurate readings of free-air temperature, the Armour Research Foundation has developed the "vortex thermometer." It is said to be accurate to within plus or minus one degree Fahrenheit.

About the Motor Show

FOLLOWING last week's Motor Show Guide number of *The Autocar*, today's (October 18) issue will be the Show Report, providing complete reference to the Earls Court exhibits and including many special features. The trio of special numbers will be completed next Friday by the Show Review.

RECOGNITION: At the recent annual cocktail party held by Fairey test pilots at Ringway, G/C. Gordon Slade (right) superintendent of flying, presented a silver cigarette box to Mr. Denis Oliver, who earlier this year was awarded the G.M. for rescuing his observer from a crashed Firefly. Mr. Oliver is a staff pilot with No. 5 Civilian Anti-Aircraft Co-operation Unit at Llanbedr, N. Wales.

DE HAVILLAND ENGINE RESEARCH SPEEDS THE WAY AHEAD

A series of paintings by W. Howard Jarvis, S.Av.A., illustrating aerodynamic shock-waves.

No. 5

M=2·6

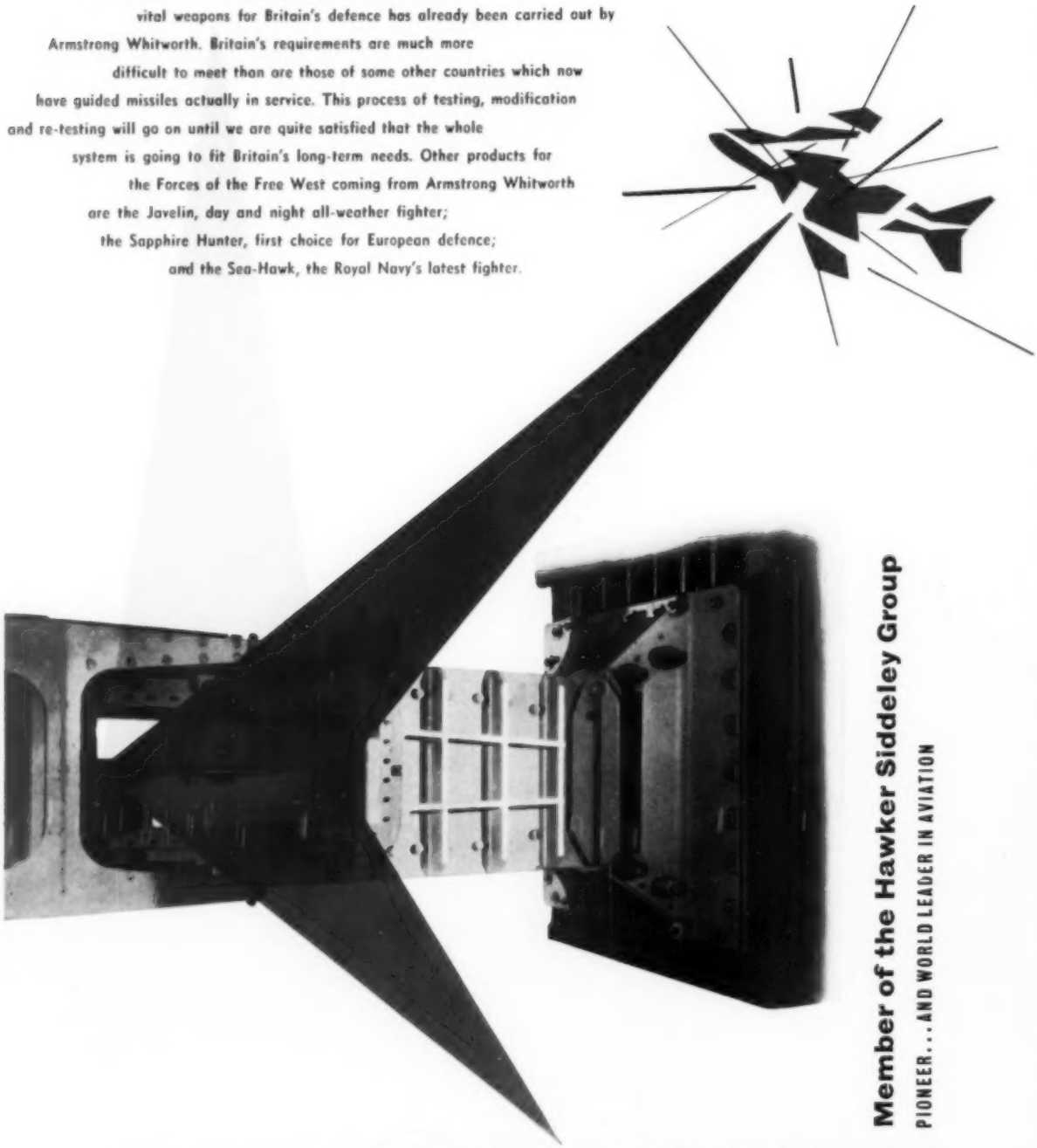
Manoeuvrability at extreme speed and altitude is graphically illustrated in this painting of a hypothetical aircraft as it reverses direction in the stratosphere. In addition to the typical shock-waves from the air frame, the diamond-type shock pattern is clearly seen in the high-velocity rocket efflux.

DH ENGINES

GYRON GYRON JUNIOR SPECTRE

pioneer in guided missiles

A great deal of testing, design studies and development of these vital weapons for Britain's defence has already been carried out by Armstrong Whitworth. Britain's requirements are much more difficult to meet than are those of some other countries which now have guided missiles actually in service. This process of testing, modification and re-testing will go on until we are quite satisfied that the whole system is going to fit Britain's long-term needs. Other products for the Forces of the Free West coming from Armstrong Whitworth are the Javelin, day and night all-weather fighter; the Sapphire Hunter, first choice for European defence; and the Sea-Hawk, the Royal Navy's latest fighter.



Member of the Hawker Siddeley Group

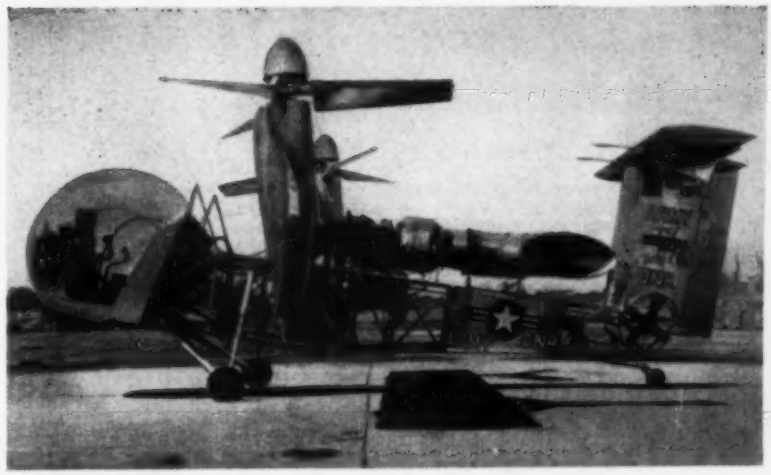
PIONEER... AND WORLD LEADER IN AVIATION

Sir W. G. Armstrong Whitworth Aircraft Limited

BAGINTON · COVENTRY

VTOL Design Problems

The Tilt-wing Formula Discussed in Lecture by Vertol Design Chief



The prototype tilt-wing Vertol 76 with its propellers in the "rotor" position. Pitch control is by a horizontal fan in the tailplane and yaw by a vertical fan in the fin.

INDICATIONS of widening spheres of interest were in evidence at the first meeting of the Helicopter Association's 1957-58 lecture programme, held in the R.Ae.S. library on October 4, when a paper entitled *"Some Design Problems of Tilt-wing VTOL Aircraft"* was presented by Mr. W. Z. Stepniewski, chief of research and development, Vertol Aircraft Corporation. The chairman was Professor J. A. J. Bennett.

Mr. Stepniewski began by saying that the tilt-wing/propeller concept represented the most promising VTOL configuration where the aim was to provide a machine with a speed range of between 300 and 400 kt and five minutes of hovering time. Two important advantages of the configuration were the relatively high rates of payload to gross weight and the relatively low fuel-consumption at cruising speed. If the required hovering time was greater than five minutes, the tilt wing showed up even more favourably than other types of vertical-lift aircraft. This was particularly true in the case of comparison with turbojet-supported machines, but where extended hovering was required for any particular operation the conventional helicopter provided the best answer. In fact, an important conclusion he had drawn from his investigations was that while the tilt-wing convertible offered numerous unique advantages for certain types of operation, the VTOL would never supersede the helicopter entirely.

One of the most difficult design problems to resolve was that of matching the power requirements for hovering flight with those for normal cruising speed. Much more power was required in the hovering condition and in multi-engined convertibles it might be found expedient to switch off one or more of the engines in cruising flight.

The most important design parameters to be considered were rotor-propeller disc-loading, rotor-blade geometry and tip speed, wing loading, and wing aspect-ratio. These could not be considered independently, since it was desirable to have the entire wing area submerged in the rotor-propeller slipstream to prevent stalling of the wing during transition from one flight condition to another. Where a cruising speed of approximately 300 kt was required for shorter ranges (of, say 200 miles) a low-aspect-ratio wing having a high loading of about 100 lb/sq ft and two rotor-propellers seemed an attractive compromise . For longer ranges, a high-aspect-ratio wing with slightly lower loading and four rotor-propellers appeared to become more advantageous. The lecturer then outlined in mathematical terms the factors which had led to the choice of values of these parameters in the design of the Vertol Model 76 flying test-bed.

The rotor-propeller of the tilt-wing aircraft performed the dual task of a rotor in hovering and a propeller in forward flight. It was necessary therefore to make the same thrust generator the most efficient lifting and propelling device. In addition, a margin had to be provided between operational and maximum-section lift-coefficient to allow for their use as a source of control forces and moments in the hovering and near-hovering conditions. In general, the desired results could be achieved by observing the following conditions:—

(a) Solidities would be rather high, and in order to reduce them efforts should be made to develop aerofoils that would permit operation at high average rotor lift coefficients and high tip speeds in hovering.

(b) Large collective-pitch changes between hovering and forward flight had to be expected and should be allowed for in the design of pitch controls.

(c) The optimum twist-distribution of the rotor-propeller for the cruising flight condition should be selected in preference to the optimum twist-distribution for hovering.

(d) Allowance should be made for rotor-propeller speed to be considerably greater in hovering flight than in the cruise condition.

Obviously, the transition from hovering to forward flight and vice-versa were the most important manœuvres to be considered from the design point of view. Transitions could be of two forms: one was a straightforward tilting of the wing while the machine maintained constant altitude; the other was a pilot technique involving variation of altitude during the transition to ensure that the wing angle-of-attack remained substantially constant throughout the operation. In other words, the transition from hovering to forward flight was made while gaining height and increasing forward velocity, whereas the transition from forward flight to hovering was made whilst gaining height and decreasing airspeed. The flight path in the latter case took the form of an exaggerated flare-out, allowing height to increase. The machine was then lowered vertically after forward speed had fallen off.

There was still a considerable lack of theoretical and experimental data regarding the behaviour of wings and rotor-propellers in this flight regime, and many of the problems associated with the prediction of forces and moments acting on the wing-propeller assembly still awaited solution. However, with the use of models it had been established that the rate of wing tilt was probably one of the most important parameters. It appeared that whereas fast rates of tilt were advantageous in the transition from hovering to forward flight, the reverse applied during the opposite manœuvre. In fact, even a complete tilt over a period as long as 45 sec might not be slow enough for transition from cruise to hovering at constant altitude if wing stalling problems were to be avoided.

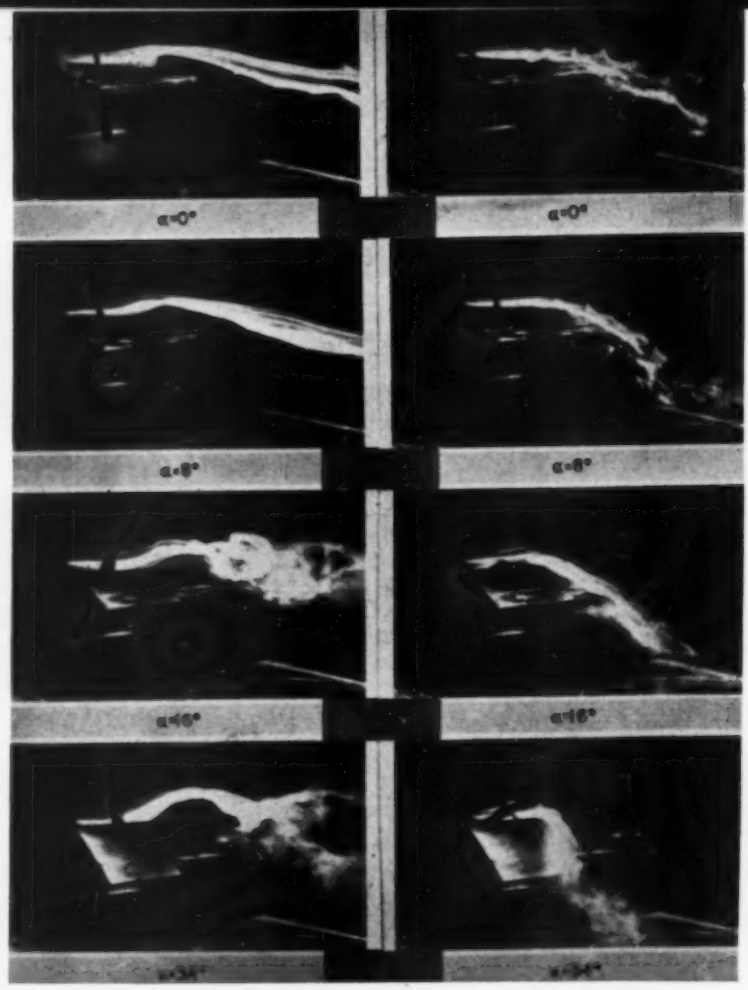
Stability considerations of the tilt-wing VTOL in hovering and slow flight were similar to those of the conventional helicopter. The VTOL problem was complicated, however, by the introduction of forces acting on the wing itself which tended to accentuate unstable tendencies under certain conditions, particularly in the fore-and-aft sense. A good deal of work had been carried out with analogue computers, and pilots had been able to "fly" the analogue in the early design stages to assist in the determination of acceptable stability characteristics. There would still be much more work to be done when flight-test results were available in sufficient quantity; but from present knowledge it appeared that satisfactory solutions were technically feasible.

Mr. Stepniewski went on to describe the Vertol Model 76 flying test-bed in detail. Originally, they had set out to build a much smaller machine but the more ready availability of the T53 free-shaft turbine had led them to design the machine around that engine. Consequently, its gross weight was in the region of 3,000 lb. The machine was completed in eleven-and-a-half months from the date of the contract.

To obtain uncoupled pitch and yaw control moments and at the same time utilize a known control system (a complete Bell 47 helicopter cockpit with full controls is incorporated in the Vertol Model 76), it was decided that two separate tail-rotor control fans would be used. One was mounted vertically in the lower fin for yaw control and the other horizontally in the tailplane for longitudinal pitch control. Lateral control in roll was achieved by means of differential collective-pitch control of the two rotor-propellers. Vertical control was by means of the conventional collective-pitch lever, which varied collective-pitch of the two rotor-propellers simultaneously. Orthdox aeroplane control surfaces in the wing and empennage, actuated by the same stick and rudder pedals, were also incorporated for forward flight.

Control runs were so arranged that change-over from hovering to forward-flight controls was automatic as transition took place. The only controls which retained the same function in both regimes were the collective-pitch lever and twist-grip throttle. The pilot's switch to operate the wing-tilting mechanism was located on the "cyclic pitch" stick.

Since autorotation of the rotor-propellers was unlikely in the event of engine failure while hovering, it would be necessary in such a case to tilt the wing back to the horizontal position and



Smoke-tunnel tests of the Vertol 76 configuration. Flap deflection 60 degrees. Left, power off; right, power on.

VTOL DESIGN PROBLEMS . . .

effect a conventional glide landing. The permissible delay in initiating this action was one second and the minimum height from which a safe recovery could be made was in the region of 1,500ft. To ensure that the pilot retained control throughout the conversion manœuvre, the tail rotor fans were driven by shafts directly connected to the rotor-propellers, which would continue to rotate because of their kinetic energy. Alternatively, if the whole conversion operation were carried out at a height of approximately 50ft, the results of power failure at this height should not be catastrophic.

The rotor hubs of the Model 76 incorporated flapping hinges, and the blades were of wooden construction with stainless-steel protective strips on the leading and trailing edges. Rigid rotor-propellers appeared to be attractive from the point of view of design simplicity but they would be considerably heavier. The use of flapping hinges in the current design avoided the possibility of large hub-moments during conversion, the trimming of which might create a large additional demand on the tail-rotor control fan.

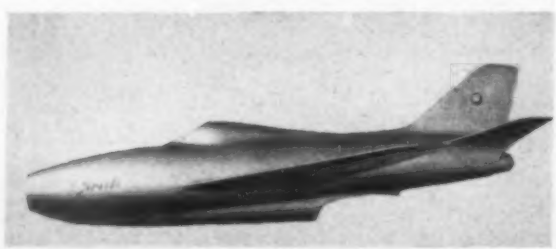
The lecturer concluded by showing two films of progress on the project up to the present time. The first was mainly concerned with smoke tests of wind-tunnel models and the second showed the initial ground running and taxying trials of the prototype aircraft. The second film ended, dramatically, with a sequence showing a free-flight vertical take-off up to the hovering position.

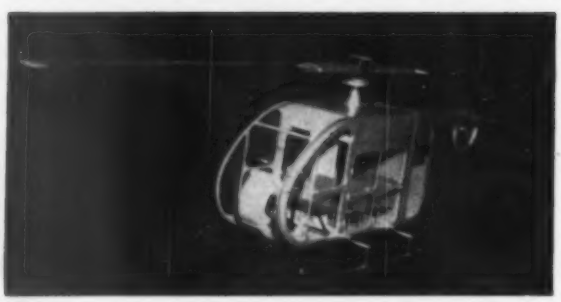
The Discussion. In opening the discussion, the chairman thanked Mr. Stepniewski for his description of their very creditable achievement and said the Association was indeed honoured by his acceptance of the invitation to speak and by the fact that he had made the journey over from the U.S.A. specifically for that purpose. In the general discussion that followed a number of speakers asked a variety of questions concerning performance details of the project. These included questions regarding the accuracy of weight estimates, stability and control problems, and the safety factors.

In reply, Mr. Stepniewski said that they were still in the dark as far as some of the weight-estimating problems were concerned, but experience with results being obtained from the first prototype was beginning to show the way. The questions of stability and safety factors were bound up in the whole design philosophy. Obviously they had to accept some penalties for the privilege of being able to hover *and* proceed at high forward speed. Again, experience with the first prototype would be invaluable in producing acceptable solutions to these problems. They did not favour the principle of using tail-rotor control fans as a permanent feature of the design, but these had been used in the first machine as the simplest solution which had enabled a great deal of time to be saved. Eventually a more sophisticated solution would be applied.

Mr. Stepniewski did not think that the possibility of carrying additional powerplants for take-off use only was necessarily the wrong philosophy. Such a practice would enable a VTOL to operate at maximum power efficiency in both hovering and forward flight—and, after all, fixed-wing airliners already carried with them heavy undercarriage assemblies which they used only twice in any one flight. The initial hovering trials of the Model 76 were proceeding satisfactorily and he had just been informed by cable that the longest flight so far achieved had been of eight minutes' duration.

NEW ITALIAN PRODUCTS ON SHOW





AMONG exhibits at the recent "Technical Salon" in Turin was a turbojet designated Fiat 4032 and having a thrust of 6,600 lb for a weight of 1,100 lb. It bore a distinct resemblance to the Bristol Orpheus, for which Fiat have a licence, and the engine shown may well have been a mock-up of the Orpheus 12. Also exhibited were a tip-drive jet helicopter seating seven people and a model of the Aerfer Ariete mixed-power development of the Sagittario 2.

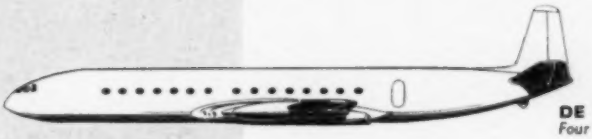
Agusta showed their licence-built Bell 47J and Macchi the mock-up of the MB.326 Viper-powered trainer. Italian Contraves showed a missile closely resembling the Swiss Oerlikon ground-to-air beam rider with gimballed rocket motor and fore-and-aft moving wings; but it was described as a surface-to-surface weapon made in Italy under Oerlikon licence.

The Fiat helicopter is already under construction, together with the Fiat 4700 air compressor which will power it. The latter produces 530 h.p. for a weight of 286 lb; gas flow is 7.46 lb/sec. The unit is installed in the tail of the oval cabin. A tail-rotor mounted within a shroud ring, and a trimming surface, are features of the design.

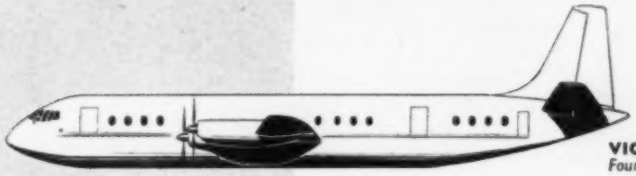
Empty weight of the helicopter is 1,320 lb; useful load is 1,760 lb; maximum speed, 106 m.p.h.; ceiling at full load, 11,150ft; and range, 185 miles. Some 87 cu ft of volume are available for freight stowage in the central portion of the cabin. The two-bladed rotor is not of Fiat design and is probably prepared by Sud Aviation.

Models of (above left) the Aerfer Ariete with rocket motor in the tail and (left) the new Fiat seven-seat, tip-drive helicopter.

VICKERS VISCOUNT
Four Dart prop-jets



DE HAVILLAND COMET
Four Avon turbo jets



VICKERS VANGUARD
Four Tyne prop-jets

BRITISH BUILT AIRLINERS

powered by

ROLLS-ROYCE

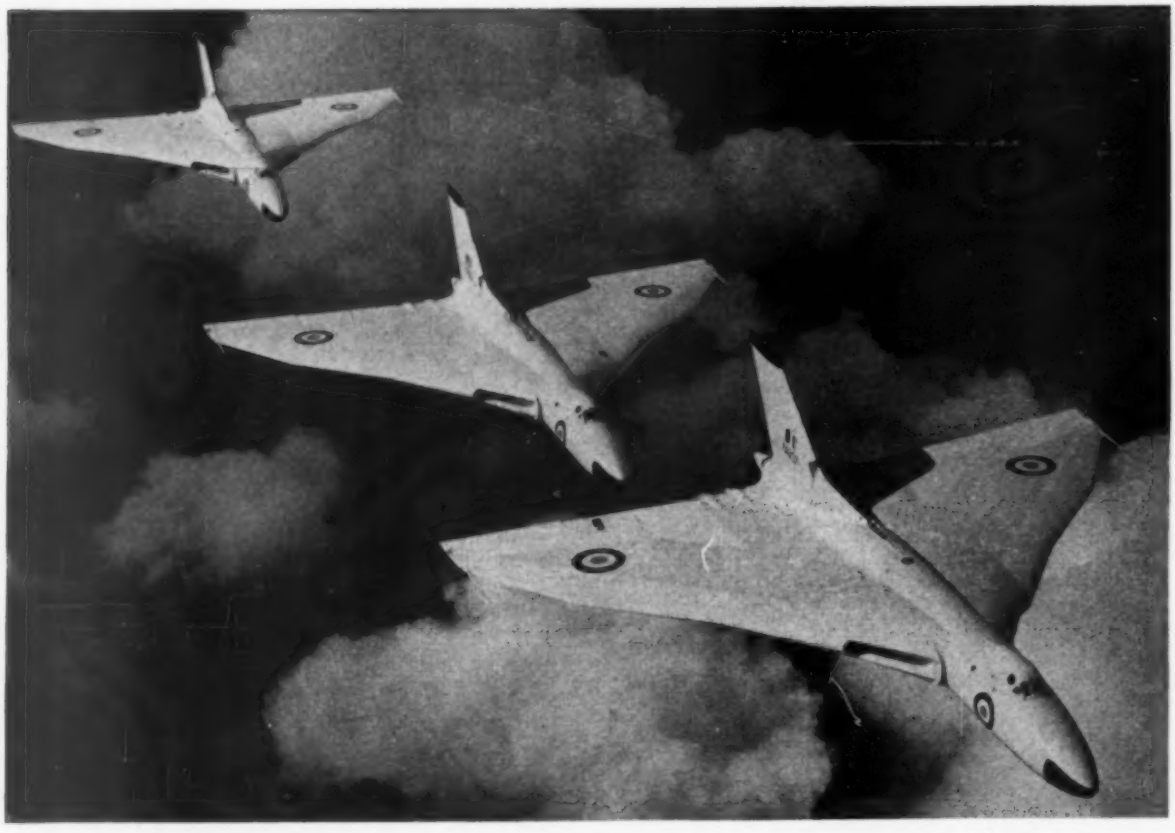
GAS TURBINES

AVIATION TRADERS ACCOUNTANT
Two Dart prop-jets

ARMSTRONG WHITWORTH 650
Four Dart prop-jets

HANDLEY PAGE HERALD
Two Dart prop-jets

ROLLS-ROYCE LIMITED • ENGLAND • SCOTLAND • CANADA • AUSTRALIA



"Equal to, if not better, than any Bomber in the World"

—Mr. C. I. Orr-Ewing, Under Secretary for Air.

In announcing that the famous 617 Squadron—the Dam Busters—is to be reformed and equipped with the Avro Vulcan Delta Bomber, believed to be the fastest bomber in service anywhere. Mr. Charles Ian Orr-Ewing, Under Secretary for Air, has said that in the Vulcan "we now have a bomber aircraft which is equal to if not better than anything else in the world".

"The Vulcan comes from a good stable"

In addition to Mr. Orr-Ewing's tribute, Air Officer Commanding No. 1 Group, Bomber Command, had this to say: "We are extremely pleased with the Vulcan, both from the operating and the maintenance aspects. The way in which this large aircraft and its complex system has been brought into use in the front line of Bomber Command, without any of the enforced groundings so frequently experienced with new types of aircraft, is most gratifying. The Vulcan is giving us splendid utilization; indeed, it is far better than we experienced with any other type of aircraft, large or small. The Vulcan comes from a good stable and is liked by the servicing crews as well as the flying crews."

We are proud of our stable—from it have come: *the Avro '504'—the first long-range bomber of World War 1; the faithful Anson; the immortal Lancaster, used by the Dam Busters in World War 2; and now the Vulcan.*

A. V. ROE & CO. LTD. · MANCHESTER

MEMBER OF THE HAWKER SIDDELEY GROUP/PIONEER...AND WORLD LEADER IN AVIATION

VIBRATION RESEARCH

Stroboscopic Techniques in Structural-fatigue Investigations

CONTRARY to what might be inferred from reading the popular Press, metal-fatigue is not an invention of the aircraft industry. But there can be no doubt that the problem is of more moment in this field than in any other, not only because of the catastrophic consequences of any mechanical failure, but also because over-dimensioning as a short-cut to greater strength is a luxury which cannot be afforded when every pound of structure weight has to be paid for dearly.

Vibration Research. In the search for safety with economy, many factors have to be taken into account, one of the most important being vibration and its effects. In addition to engine-induced vibrations (which vary widely in character according to whether the engines are of piston or gas-turbine type), aerodynamic loads, gust conditions, flutter, pressurization cycles and landing stresses must also be considered.

The analysis of these and other factors, which may or may not be augmented by the presence of resonances in various parts of the airframe, is an exceedingly complex matter. Despite the great advances which have been made in mathematical methods of study, towards which the electronic computer is making an increasingly valuable contribution, comprehensive physical vibration tests are still required before any component, or complete aircraft, is proved fit for service. A wide range of equipment is now available, both for the application of any required vibrating stresses, and for the measurement and interpretation of the behaviour of parts subjected to such simulated service conditions.

Among the most useful aids available to the vibration investigator is the stroboscope, which in its latest form has been developed from a laboratory gadget into a robust, adaptable and accurate piece of shop-floor equipment. Its ability to "freeze," "slow down" or "reverse" any cyclic operation provides a means of studying the behaviour of vibrating parts *in situ* without interfering with their movement.

Work on Test Specimens. In investigations into vibration in aircraft structures at their Chadderton, Manchester, works, A. V. Roe and Co., Ltd., have found that the thoughtful application of stroboscopes in this field can save a great deal of time and trouble.

A typical example is seen in the first illustration, which shows a test rig in which a material test specimen is being subjected to an alternating stress to determine the effects on fatigue resistance of different methods of forming and heat treatment. The test-piece consists of a curved bar, mounted at the top of the rig, to which the oscillating load is applied vertically by a motor-driven eccentric. This stress is superimposed on a static load consisting of a number of weights suspended on bungee cords from a cross-beam through which the load is finally applied to the test member. The stresses in the bar are recorded by means of strain-gauges, the outputs from which are fed to indicating and recording instruments, including a cathode-ray oscilloscope, seen on the left of the picture. The bar is excited at the natural frequency of the assembly so that quite a small applied load is sufficient to achieve the requisite large stress in the bar. This results, of course, in a saving in the size and cost of the driving equipment. It is in the ingenious method of ensuring that the bar is driven at exactly the resonant frequency that the use of the stroboscope has saved a great deal of painstaking work.

As the close-up picture shows, the vertical rod which transmits the oscillation from the eccentric to the cross-beam incorporates a clutch which will slip axially if subjected to more than a predetermined load, in this case that required to drive the assembly at resonance. When the motor is started up, the clutch slips until the drive attains a speed equal to the resonant frequency of the system. At that point the resistance to excitation drops below the frictional resistance to which the clutch is preset and the clutch locks. This condition is detected by directing a stroboscope at the clutch, the flash-rate control being adjusted until the reciprocation of the clutch is apparently slowed down to a speed at which the relative movement between the driving and the driven ends can be clearly seen. This movement disappears entirely when the resonant condition is reached, at which point the driving motor speed can be fixed. This procedure eliminates the necessity for first defining the natural frequency of the assembly, which would be a time-consuming process, and then accurately controlling the motor to this precise speed, with possibly a correction for a change of natural frequency when the motor is coupled to the load.

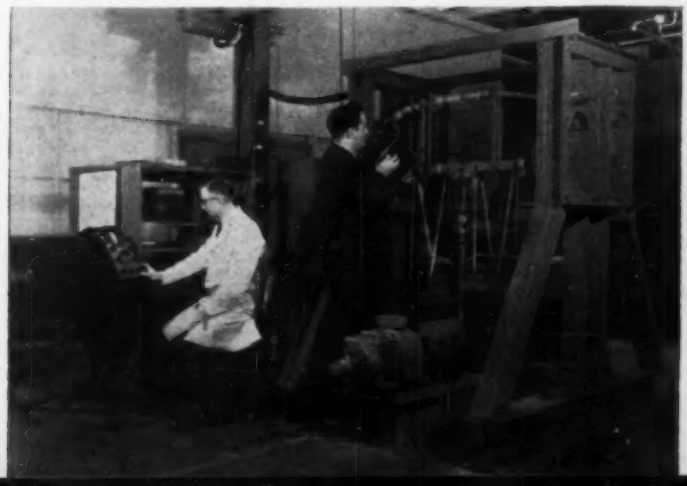
The same stroboscope is also used to examine the test bar itself. By "freezing" its motion, the appearance of cracks and their mode of propagation can be observed and the sequence of failure followed. In addition, the speed control of the stroboscope is used to measure the frequency of vibration.

The stroboscope used in this test is a Type 1200 Stroboflash manufactured by Dawe Instruments, Ltd., of 99 Uxbridge Road, London, W.5. As the illustrations show, it is a portable mains-operated instrument easily held in one hand and controlled with the other. The neon flash tube is triggered by a valve oscillator, the variable speed control incorporating a calibrated dial covering the range from 250 to 18,000 flashes per minute. The precision of calibration is such that the stroboscope can be used to measure speeds and frequencies of vibration to an accuracy of 2 per cent below 1,000 r.p.m. and to 1 per cent at higher speeds. Rates beyond the direct range of the instrument can be measured by arranging that the flash rate is a sub-multiple of the frequency to be measured. The practical upper limit of speed measurement by this means is about 100,000 r.p.m., which provides a very useful extension of the unit's field of application.

A perfectly stationary image, regardless of any variation in the speed of the mechanism under observation, can be obtained by using a special contactor unit which locks the flash rate in exact synchronism with the motion, while a phasing device permits the mechanism to be "frozen" at any chosen point in its cycle.

Fatigue Tests on Airframe Surfaces. The same stroboscope is shown again in the picture (p. 610), where it is being used in a vibration test of a more operational nature. The object mounted in the rig is a section of an aircraft fin which is being subjected to vibration in accelerated simulation of the repeated lateral gust loads met with in flight. The vibration source is similar to that in the previous example, the load being applied *via* a slipping clutch at the lower left, through a vertical linkage (not visible in the picture) and thence to the horizontal rod at the top left. The correct load distribution over the fin surface is obtained by using a system of levers of appropriate lengths. By adjusting the lengths of these levers and the positions of the fulcrums, any desired

Using a Stroboflash to "freeze" a test specimen being subjected to a vibration test. The origin and method of propagation of fatigue cracks can be studied as they occur. (Right) The specimen is excited at resonance through a slipping clutch device which will lock only when the system reaches resonant frequency. The point at which this occurs can be detected by means of the stroboscope.



A stroboscope being used to study the propagation of fatigue cracks in tail-fin ribs while the structure is subjected to vibration in simulation of the sideways gust loads met with in flight. (Right) For calibrating vibration pick-ups, the Stroboflood on the left is used to "slow down" the motion of the image of the arcuate scale, as reflected into the telescope by a small mirror on the vibrator.

distribution can be achieved, so that the jig can readily be adapted for tests on different components. The static weight of the linkage is taken up by the bungee cords at the top, so that the fin is subjected only to the lateral alternating stresses.

The object of the test in this case is to study the effect of alternating stresses on the internal ribs, and in particular to observe the propagation of fatigue cracks at points of stress concentration round the flanges of the lightening holes stamped in the ribs.

During the test the stroboscope is directed at the rib under examination as in the illustration, and the speed control adjusted until the vibration is "slowed down" so that the rib can be seen to move slowly throughout its comparatively large amplitude of movement.

Calibrating Pick-ups. Apart from the many detailed investigations of components which must precede the construction of any aircraft, the full-scale vibration testing of complete airframes and major units like wings and fuselage, statically and in flight, is nowadays a most important part of any development programme. For this purpose large numbers of vibration pick-ups of various types are attached to parts of the structure to give an indication of the distribution and magnitude of alternating stresses induced under operating conditions. To ensure that these gauges give an accurate quantitative indication of vibration amplitude they must be calibrated against a standard. The most convenient way to do this is to subject the pick-up to vibration from an accurately known source and to calibrate the output of the pick-up against the known amplitude of its movement. At Chadderton, an ingenious method has been devised in which a stroboscope is used to overcome the difficulty of measuring the amplitude of the calibrating vibration dynamically to a high degree of accuracy. The stroboscope enables this to be done without imposing any additional load on the vibration source, which might affect its behaviour and give rise to misleading results.

The calibration set-up is seen in the fourth illustration. The pick-up itself, which is apparent towards the right of the picture, consists of a rigid U-shaped member embracing a flexible beam between its arms. In normal use, the entire unit is clamped to a rigid structure placed near the aircraft and the beam is deflected by the vibration it is desired to measure, the amount of movement being recorded by means of a strain-gauge, whose output is fed to an amplifier and recorded on an oscilloscope. For calibration, the pick-up is mounted on an electromagnetic vibrator, the flexible beam being connected by an extension rod to the vibrator spindle. The strain-gauge output is fed to the oscilloscope at the rear, which operates with a zero time-base so that the amplitude of vibration is indicated simply by the height of a vertical trace.

A large arcuate scale is mounted at the left-hand end of the bench in such a way that the image of a portion of it is reflected by a small mirror, mounted on a lever attached to the vibrator spindle, into a telescope sighted on the mirror. The armature of the vibrator is first moved manually through increments of 0.001in, checked by micrometer. The resulting deflection of the mirror produces a greatly magnified movement of the scale as seen through the telescope. The scale can therefore be calibrated, statically and with great accuracy, in terms of actual amplitude of movement at the pick-up. The vibrator is then excited at mains frequency and the input adjusted by means of a Variac control, until the total excursion, as indicated by the movement of the scale image, is 0.020in. It is, of course, impossible to check this with the unaided eye, because the magnified reflection of the scale is oscillating at 50 c.p.s. and would appear to the operator as a blur. The difficulty is overcome by illuminating the scale with a stroboscope, and adjusting the flash rate until the image appears to be moving very slowly, so that the limits of its apparent movement can be clearly defined. When the excursion is shown by this means to be 0.020in, the oscilloscope is adjusted to give a vertical deflection of 10 cm on the cathode-ray tube, which is then in effect calibrated against the actual amplitude at the pick-up.

A number of similar pick-ups, which incorporate a means of adjusting their strain-gauge output, can then be calibrated to the same standard, simply by adjusting their output to give the same C.R.T. deflection for the same vibration amplitude. This procedure has been found to give very accurate results, its particular attraction being that the use of the stroboscope permits a dynamic phenomenon to be compared precisely with a static measurement. It will be noticed from the picture that the Stroboflash itself is not directed at the arcuate scale, which is instead illuminated by a larger instrument, because the light output of the former, although adequate for most purposes, is not sufficient to show up clearly against the bright background lighting. The actual light source is a Type 1201 Stroboflood, incorporating a special three-electrode xenon-filled discharge tube which, operated through a condenser, produces a high-intensity white light the duration of which varies between 25 and 40 microseconds according to the flash rate. This unit has no speed control, and must be triggered by a contactor, or by the speed control of the Stroboflash, as in this case. The two instruments described form only part of a range of stroboscopes with wide application to vibration research.

Resonance Search Tests. Perhaps the most interesting instrument in the range, from the point of view of vibration investigation, is the Type 1206 Slow Motion Stroboscope, which has been specially designed for resonance search testing. It consists of an oscillator which drives, through an amplifier, a vibration generator as well as a stroboscope. The stroboscope, however, does not flash at exactly the same rate as the vibrator but is triggered through a phase shifter at a constant difference frequency, which can be selected at ½, 1, 1½ or 2 c/s., irrespective of the frequency of the vibrator. In practice, the subject of a resonance search is mounted on the vibrator, while the frequency control is swept through the required range. Illuminated by the stroboscope, the component under study appears to vibrate at the preselected slow motion throughout the test, irrespective of the true frequency of excitation. Should any resonance occur, the part concerned will be seen to vibrate with greatly increased amplitude but still at the same slow rate. The frequency of the resonance is indicated accurately on the oscillator control dial and, if it falls within the range of vibrations to which the component may be subjected in service, the need for modification is indicated. The wide frequency-range of this instrument—from 10 c.p.s. to 500 c.p.s.—provides coverage of virtually all vibration conditions likely to be met with in the aircraft field.

ICE AIRFIELDS

THE United States Air Force has succeeded in landing wheeled aircraft weighing more than 60 tons on Arctic sea ice little more than 4ft thick, according to a recent announcement by the U.S.A.F. Air Research and Development Command.

Trials made near Thule A.F.B., in Greenland, showed that heavy transport aircraft could be put down on sheet ice without melting or breaking it. Neither the weight of the aircraft nor jet heat caused any serious deterioration of the ice.

Using pickaxes for tools and inner tubes for runway markers, four men hacked out an 11,000-ft runway for the tests in two days.

The purpose of the programme is to compile accurate tables of the bearing strengths of both fresh and sea-water ice, and to develop an airborne indicator of ice thickness and strength using seismic, impact or electro-magnetic principles.

A New Realm of Flight

COMPARABLE in its significance to the harnessing of atomic energy, the successful launching of the first man-made satellite of the Earth was a unique scientific and engineering achievement. It marked Man's entry into a completely new realm of flight. On these four pages are presented the first week's news of the satellite, a general discussion of the underlying principles, and quotations concerning the achievement.

THE first surprising week in which the Russian satellite orbited the Earth was one of contradiction and speculation. By the end of it, however, a clearer picture was emerging. More accurate scientific measurements were enabling the orbit to be precisely established, and considered comment was following the almost hysterical reaction which in certain places had greeted the first announcements.

The early announcements, reported in last week's issue, gave the satellite's weight as 184 lb and diameter as 22.8in, and contained forecasts (which proved to be accurate) concerning the times at which the object would pass over points beneath its orbit. The Russian name for the satellite was *sputnik* (or fellow-traveller) and its two radio transmitters were working on frequencies of 20.005 and 40.002 Mc/s. Its speed was approximately 18,000 m.p.h. and its height 560 miles.

On Monday, October 7, Moscow Radio stated that the final section of the satellite's carrier rocket was also in orbit. The first substantial reports of sightings of the satellite or its rocket came from Australia, and continued reception of the satellite's radio signals was reported from many countries, including the United Kingdom. In Barcelona, the International Astronautical Conference opened, with two Russian papers concerning Earth satellites on its programme. The Russian delegates to the International Geophysical Year conference in Washington visited the Naval Research Laboratory, which is responsible for the U.S. Project Vanguard satellite programme [the American satellite project was the subject of a paper at the recent Rockets Symposium at the College of Aeronautics, Cranfield, reported in *Flight* of August 2].

At a Press conference organized by the Royal Society in London on Tuesday, October 8, British knowledge of the Russian satellite was discussed. Among the speakers were Dr. D. C. Martin, assistant secretary of the Society, who spoke of the U.K. contribution to the International Geophysical Year; and Sir Owen Wansborough-Jones, chief scientist to the Ministry of Supply, who emphasized that, while his Ministry was contributing rocket information to the I.G.Y. programme, M.o.S. interest in satellites was "not very much concerned with defence."

Techniques and results in the tracking of the satellite were described by Dr. R. L. Smith-Rose, director of the Radio Research Station at Slough; Mr. Martin Ryle, director of the Mullard Radio-astronomical Laboratory of Cambridge University; and by B.B.C. engineers. Mr. Ryle said that the time taken for one orbit was 96 min and that the satellite's height had been estimated at 250 miles (approaching from the south-west) and 400 miles (from the north-west). Predictions of the precise orbit as an aid to visual observations were being carried out with the help of scientists from the Royal Observatory. Dr. Martin pointed out that the I.G.Y. authorities had been informed in advance of the radio frequencies on which the satellite would transmit.

As the Royal Society meeting was taking place in London, preparations were being made at Jodrell Bank, Cheshire, to use Manchester University's radio telescope to track the satellite by radar.

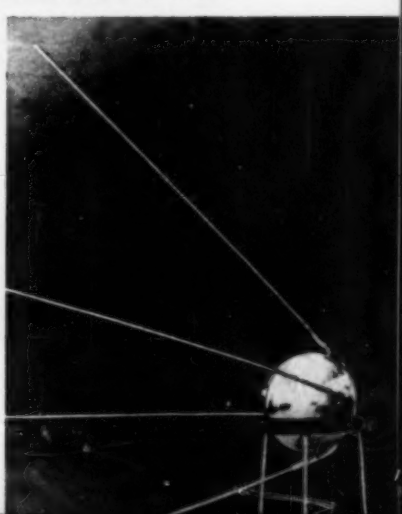
On Wednesday, October 9, Moscow stated that a third object, the protective nose-cone, was in orbit. Highest point of the orbit of the satellite was given as 625 miles, while British measurements of the radio transmissions were said to indicate a minimum height of 160 miles and a mean height of about 400 miles. According to *Pravda*, temperatures and other data were being transmitted by the satellite. Preliminary analysis had indicated lower temperatures and density than expected at heights between 200 and 300 miles.

Also on October 9, President Eisenhower stated that the first American satellites, small test spheres, would be launched in December. These would be used to check rocket instrumentation and ground tracking equipment, and would be followed by the first fully instrumented satellite in March next year. At the Royal Observatory, Edinburgh, two scientists reported the first visual observation in Britain of the satellite or its rocket.

By the afternoon of Friday, October 11, the satellite had completed 100 circuits of the Earth, and Moscow Radio reported that evening that it had covered 2,734,000 miles, equivalent to more than ten times the distance to the Moon. At a meeting of the Royal Astronomical Society in London, Mr. Martin Ryle said that the elliptical path of the satellite was making available "enormous information about the ionosphere." Radar tracking of the satellite's rocket had begun at Jodrell Bank on Thursday evening.

In the United States, Dr. John Hagen, director of Project Vanguard, said that the American programme was about five months behind schedule, and went on to accuse Russia of "unethical conduct" in launching her satellite at this time.

By Monday, October 14, the satellite had completed 150 circuits, and observations showed that the rocket was now ahead, i.e., its speed had increased and it was nearer the Earth. Uncertainty as to whether the satellite was transmitting data such as temperatures by variation of the transmitted signals remained (for contradictory Russian statements, see page 614), although general opinion was that it was not. (*Continued overleaf*)



The satellite—a Moscow photograph released on October 9. In the heading is the first view of it—or, more likely, of its rocket—in orbit, taken (with a 60 sec exposure) by a photographer in Melbourne, Australia. The faint semicircular trace is unexplained; it could be merely a scratch on the negative.

A NEW REALM OF FLIGHT . . .

Satellite Principles

TO send a satellite around the Earth, so that it moves steadily in an orbit until traces of gas and meteoric dust cause it to fall and burn up in the high atmosphere, it is necessary to supply the satellite with potential and kinetic energy (height as well as velocity) and to set it on its desired path. This can only be done by a rocket-driven vehicle fitted with accurate guidance, because any air that would sustain ordinary engines is left far behind soon after the moment of launch, and because small errors in direction have a very large effect on the shape of the orbit that is achieved.

The rocket system used for the Russian launching vehicle is said to be composed of three stages. These can be separated in flight, so that the later stages do not have to accelerate the mass of the empty earlier stages, and so can rise to great heights. A possible form of three-stage launching vehicle is shown in Fig. 1: the first stage is probably the lowest stage of an intercontinental ballistic missile. After a vertical take-off, this will get the vehicle up to a height of about 50 miles and a velocity of, say, 4,000 m.p.h. (see Fig. 2). During this part of the flight, the control system (which may be in the second stage) will tilt the vehicle so that it begins to point in the general direction of the orbit.

When the propellants are consumed, the separation device between the first and second stages is actuated, so that the first stage is free to fall back to earth: it may land, say, 300 miles from the launching point. After separation, the second stage will be fired, and this will get the remaining parts of the vehicle to an altitude of 200 miles and a speed of 10,000 m.p.h. There may then be a long coasting period, during which the vehicle rises almost to orbit height, and in which auxiliary "vernier" rockets in the second stage place the vehicle on the precise path to give the proper final orbit: this will be done with the aid of the computers in the guidance compartment. When the vehicle is finally on course, the second stage is separated (extremely gently so as not to disturb the third stage) and will fall to earth in its turn, from an altitude of about 500 miles. The velocity of re-entry of the second stage will be so high that it may burn up.

The third-stage rocket, with the satellite on the front, will then be fired, so placing the satellite securely in its orbit at an altitude of 500-600 miles with a velocity of 18,000 m.p.h. Final separation of the satellite from the third stage will be done by a simple spring or small explosive device, controlled by clockwork and started from the second stage before it was separated: a relative velocity of only a few feet per second is required, since the satellite and third-stage rocket will gradually drift apart. If the nose cone has not been separated earlier, it will be jettisoned now. The total take-off weight of the launching vehicle is likely to approach one thousand times that of the satellite itself, that is, about 80 tons for a satellite of 184 lb.

The Russians stated that the orbit in which the satellite is travelling is inclined to the equator at 65 deg; that is, at its furthest passage north and south of the equator, the satellite is over latitudes 65 deg north and south. (Fig. 3.) The plane of the orbit remains nearly stationary in space (in fact it rotates slowly, because of the effects of the Earth's oblateness), and this means that, since the satellite makes one revolution about the Earth in about 1½ hours, the Earth rotates under the satellite orbit during each revolution by the angle which it always moves in this space of time, namely 360 deg × 1½/24, or 22½ deg. To observers on the Earth, therefore, it seems as though every orbit is twisted about the Earth by about 22½ deg.

As the Earth makes one complete rotation, any place on its surface (between latitudes 65 deg N. and 65 deg S.) will be beneath the orbit of the satellite on two occasions. The satellite will pass over a given position—or fairly near it—twice each day, once from a northerly direction and (when the Earth has completed half a revolution) once from a southerly one. The satellite can be seen from practically all the inhabited parts of the Earth, excluding only the central polar regions.

Projecting the satellite into an orbit of this type is more difficult than either making it revolve above the equator all the time, or launching it a small angle to the equator (as is to be done with the U.S. Vanguard satellite), for the high-angle orbit does not permit much advantage to be taken of the Earth's surface velocity—about 1,000 m.p.h. at the equator. A satellite launched eastward at the equator would need only 17,000 m.p.h. extra velocity, instead of 18,000 m.p.h. for a completely polar orbit, so that the Russians have chosen an orbit which is by no means the easiest to achieve. It might be remarked that any satellite must be launched into an orbit which is a "great circle," since the centre of gravity of the Earth must lie in the same plane as the satellite orbit.

The satellite having been placed in the orbit, with adequate height and speed, there remains the problem of knowing what shape the orbit will be. This depends on the angle of elevation of the satellite's path at the moment of separation, as well as its speed, and only by chance will the orbit be a circle about the Earth with the satellite travelling at constant height. The orbit will almost certainly be an ellipse for, even if the elevation angle at separation from the third stage were zero (that is, if the path of the satellite were parallel to the Earth's surface immediately below), the satellite would move towards or away from the Earth as it travelled round the orbit unless its velocity and height were so precisely matched that the Earth's gravitational attraction (which depends inversely on the square of the distance of the satellite from the Earth's centre) was exactly equal to the centrifugal force tending to make the satellite fly off tangentially.

Such an elliptical motion is stable, since as the satellite falls it converts potential energy into kinetic energy, speeds up and increases the outward centrifugal force at a greater rate than the inward gravitational force increases. The orbit will have a point of nearest approach to the Earth (perigee), at which the satellite velocity will be greatest, and a point of greatest distance away (apogee), at which the velocity will be least.

An elliptical orbit which has a considerable difference between the perigree and apogee altitudes is not in itself inferior to a

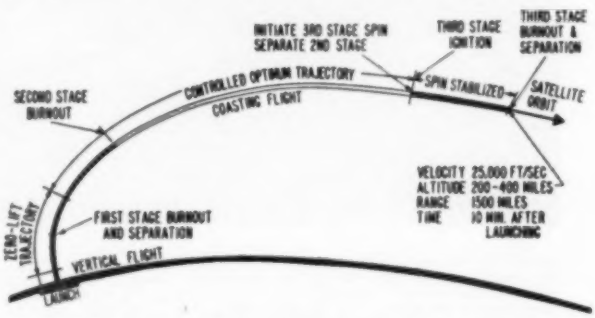
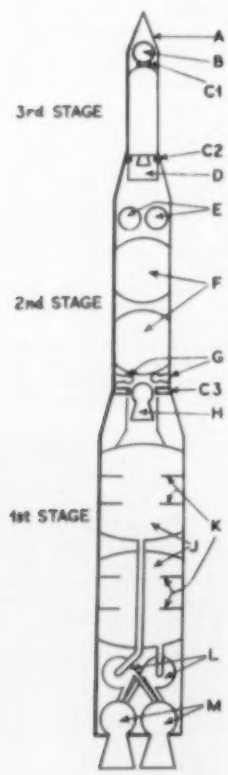


Fig. 2. Launching of satellite by three-stage vehicle. Data refers to U.S. Vanguard project; Russian launching trajectory was similar to that illustrated. (From M. Rosen's paper at the Cranfield symposium.)

Fig. 1. Possible arrangement of a three-stage launching vehicle (the diameter is slightly exaggerated to show internal features).



Overall height 180-200ft, total weight 80-100 tons. Diameter of Stage 1 about 15ft. Stage 1 would have at least two liquid-propellant motors (gimbal-mounted for guidance) with a total thrust of say 250,000-300,000 lb for 2 min. Stage 2 might have a single (gimballed) motor giving 30,000 lb for 60 sec. Stage 3 (no guidance system) might employ either a solid or a liquid (nitric acid/hydrazine) propellant giving 3,000 lb for 10 sec. The skin of the first stage (perhaps of stainless-steel foil) would be so thin that the rocket would not stand without propellants in the tanks to stabilize it.

A Anti-heating nose-cone, blown off at 20-30 miles
B Satellite
C1 Separation device (spring or explosive)
C2 Ditto
C3 Ditto (latch or explosive)
D Guidance for entire vehicle (gyros, accelerometers, integrators; amplifiers for gimbal jacks of 1st and 2nd stage motors)
E Helium bottles to pressurize tanks
F Propellant tanks (perhaps liquid oxygen/hydrazine, or fluorine/hydrazine)
G Auxiliary rocket motors for guidance after burn-out of main motor
H Second-stage gimballed motor
J Propellant tanks (perhaps liquid oxygen/kerosine or gasoline)
K Anti-slosh baffles
L Propellant-pumps (turbines driven by auxiliary gas-generators from main propellant supply)
M First-stage gimballed motors

circular orbit and, indeed, it has advantages, since a single vehicle can explore a great volume of near space. The lifetime of the satellite is greatly reduced, however, if it enters the atmosphere to any extent. The satellite loses energy every time it goes through perigee; this reduces the apogee distance without having much effect on perigee, until a roughly circular orbit is reached near the perigee altitude. After this, the satellite is subjected to drag all the time, and descends to Earth in a spiral trajectory: the friction of the atmosphere heats the satellite, which will probably burn up like a meteor entering the atmosphere.

The Uses of Satellites. The descent of the satellite, if it is tracked accurately, will provide perhaps the most valuable data that a simple satellite can give, namely a measure of the atmospheric density at great altitudes. We have already a fair knowledge of the drag coefficient for bodies of spherical or squat cylindrical shape, even when the density is so low that the air behaves as a quantity of free, separate particles (molecules or atoms), rather than as a fluid as at low altitudes, so that knowledge of the re-entering satellite's velocity and retardation makes possible a direct calculation of the density.

The radio units in the satellite will soon cease to transmit since they are driven by chemical batteries, but they will have served their purpose if they have guided astronomers to look for the satellite in particular regions of the sky at known times. As soon as accurate optical measurements can be made—and if the satellite stays up for any useful length of time—it will be possible to compute the orbit with an accuracy approaching that of the Moon's orbit, and this knowledge will enable at least two further important deductions to be made. The fact that, during its lifetime, the satellite will pass vertically above nearly every point on the Earth, means that, in principle, all that has to be done to find the location of two places relative to one another is to record the

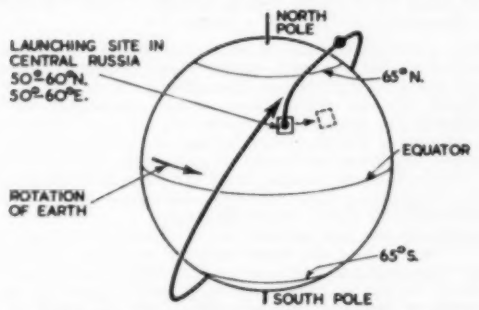


Fig. 3. Russian satellite orbit in relation to the Earth. The plane of the orbit is at 65 deg to the Equator; as the Earth rotates, the orbit appears from the Earth to move westward. In fact the orbit is effectively constant; the Earth rotates inside it, as indicated by the (dotted) position of the launching site after one orbit by the satellite.

times at which the satellite passes above (or very nearly above) them, and to obtain their latitudes and longitudes from tables of the satellite's motion. Places that are inaccessible by normal surveying methods (such as those on the opposite shores of oceans) will thus be capable of location to an accuracy that should be much better than can be done even by refined radar or hyperbolic navigation methods.

A satellite that was clearly visible at all times would, of course, be a valuable aid to all kinds of navigation but until high-powered solar batteries can be developed that would make the satellite continue to shine at night, such a device is not practicable. The other deduction that can be made from accurate knowledge of the orbit is that of the true shape of the Earth and the distribution of the masses in its crust.

Additional uses of subsequent satellites are detailed overleaf in quotations from Russian sources.

Progress in Other Countries. Although the Russians are first in the sky with their satellite, the U.S.A. was the first country to announce that it would launch satellite vehicles during the I.G.Y. The American system finally chosen is that called Project Vanguard, in which it is intended to launch a spherical satellite 20 inches in diameter, and weighing 22 lb; that is, about one-eighth of the mass of the Russian satellite. To do this, a three-stage launching vehicle is to be used, as described at Cranfield by Milton Rosen of the U.S. Naval Research Laboratory: this has a take-off weight of 22,600 lb (10 tons), and is 71ft long. The first stage gives 28,000 lb thrust for 140 seconds, using liquid oxygen and gasoline, the second gives 7,500 lb for about 30 seconds using the hypergolic propellants nitric acid and dimethylhydrazine, and the third has a 2,300 lb. thrust solid-propellant motor. All guidance is housed in the second stage and control is provided by gimballed combustion chambers.

It is hoped to put the U.S. satellites into nominally circular orbits at 300 miles altitude, but which can have perigee altitudes of at least 200 miles, apogee height being 1,400 miles or more: they will be launched from Cape Canaveral, Florida, at an inclination to the equator of about 35 deg. The programme of scientific experiments proposed is much the same as the Russians hope to do, but, since the mean density of the Vanguard satellite is only about one-eighth of the Russian one, the lifetime will be much shorter: in circular orbits at 300 miles it will be nearly a year, but at 200 miles only a few days.

It may be noted that, before Vanguard was chosen, the U.S. satellite programme was to have been based on the U.S. Army's Redstone vehicle, under the code-name "Project Orbiter": this was to have been only a two-stage vehicle, since Redstone, although only a single stage, has a very large total impulse (thrust × time of burning). The second stage was to be formed of a cluster of solid-propellant Loki rockets. It is probable that the mass of the satellite would not have been very great, but the system had the advantage of using relatively well-developed hardware, as is believed to be the case with the Russian launching vehicle. Although Vanguard's first stage is like the very successful Viking rocket, the rest is virtually all new and has had to be developed from scratch.

The intermediate-range ballistic missile development of Redstone is called Jupiter, and this has been fired successfully to full range from the Florida base: a variant, called Jupiter C, is fitted with two further stages of solid-propellant rockets, and this should put a satellite payload into an orbit without much difficulty. The first firing of Jupiter C is reported to have given a total range of 3,300 miles, even though the final part of the powered trajectory was depressed to drive the vehicle back to Earth. The second Jupiter C may well put a satellite into an orbit before Vanguard gets going.

The British contribution to I.G.Y. upper-atmosphere research, the Skylark rocket, is excellent for its purpose, but it does not have any chance, even with boost motors, of putting up a satellite. Perhaps in a few years' time there will be vehicles in this country capable of launching satellites, but the cost will be high. Dr. L. R. Shepherd, in his paper delivered at Cranfield, stated that the cost of large rocket vehicles might be between £5,000 and £10,000 per ton of take-off weight, neglecting development (which he anticipated would be paid for by the military authorities). This implies that, apart from the cost of a launching site, tracking equipment, and the scientific instrumentation for which the work is undertaken, each launch would cost, say, £100,000 for a vehicle the size of Vanguard. Altogether, the launching of ten satellites might run up a bill for perhaps three or four million pounds, and, while only a niggardly government would grudge the expenditure of such a sum, it seems more profitable to devote the money to fields in which we will not be duplicating the work of the Russians and Americans.

A Timely Lecture. Just one week before the Russian satellite became world news, the British Interplanetary Society opened its lecture programme in London with an address on *Geophysical Research with Artificial Earth Satellites* by Professor S. F. Singer of the University of Maryland. Prof. Singer began his talk by describing what he considered to be the most useful path for a satellite: this was a near-polar orbit, with an inclination to the equator of 83 deg, chosen so that the regression of the orbit about the Earth, due to the Earth's oblateness, would have a period of exactly one year. If the satellite were launched so that the orbit plane were initially normal to the Earth-Sun axis (i.e., in the 6 a.m.-6 p.m. position), it would stay in this configuration and so be always in daylight.

Prof. Singer noted that main advantages of his proposed orbit lay in the facilitation of visual observation and in the preservation of a reasonable working temperature in the satellite.

Referring to uses of satellites, Prof. Singer commented that, without carrying any instrumentation at all, a satellite of known mass and shape would give valuable data on atmospheric density, from changes in velocity during the satellite lifetime, and on the figure of the Earth, from the regression of the orbit and its variation from a true ellipse.

Even simple instruments, Prof. Singer said, could give much valuable information. For example, meteoric dust, impinging on the satellite skin, caused erosion, and by radioactive techniques this erosion could be measured by a transistorized device weighing ¼ oz. A simple photocell could make continuous measurements of the Earth's albedo (reflecting power) as the vehicle travelled above the atmosphere, so that a fair picture of the cloud distribution could be obtained for use in meteorology and weather forecasting.

Prof. Singer remarked, during the discussion that followed his lecture, that the Vanguard satellite was very much a minimum-sized vehicle: he said that his own MOUSE project of 1954 with its small cylindrical satellite, would have required much the same launching system.

[*Continued overleaf*

A NEW REALM OF FLIGHT . . .

A blackboard exposition by Dr. Blagonravov, head of the Russian delegation to the I.G.Y. Conference in Washington.

Particular Points of View

COUNTLESS statements of fact, propaganda and opinion were made during the week following the launching of the Russian satellite. Among those which deserve to be put on record were the following:—

The Earth satellite was first heard by amateur radio operators in the city of Khabarovsk in the Soviet Far East. At 01.55 on October 5 the signal was heard by a ham operator in Magadan, Siberia.—*Moscow Radio, October 6.*

It should be noted that the solution of the problem of launching multi-stage ballistic intercontinental rockets by Soviet scientists formed a preparatory stage for the creation of the artificial satellite. . . .

Possessing artificial satellites, astronomers, radio-physicists, astro-physicists, geophysicists and other scientists will be able to study all cosmic radiations in their pure unadulterated state. The more we know about these radiations, the greater will be our insight into the phenomena which occur in the Universe. The artificial satellites will help us to establish the special distribution of Earth's magnetic field, which is extremely important for unravelling the mystery of the origin of the Earth's magnetism. On the other hand they will provide data about the structure and the basic regularities of the ionosphere . . .

The data concerning the temperature, pressure, density and composition of the air will be of great importance for meteorology and for designers of ionospheric aircraft and in other problems. The entire surface of the Earth could be filmed from the satellites. This will make it possible to create a precise map of the Earth and to determine the equatorial radius and flattening of the Earth at the Poles. Of great interest will be the experiments with plants and animals under conditions of loss of gravity which is of great importance for the development of space travel.—*N. A. Varvarov, chairman of the astronautics section of the U.S.S.R. Central Aero Club, Moscow, October 6.*

The study of the movement of the first satellite, its period of existence, the conditions under which it approaches the Earth on a spiral, will make it possible to obtain more precise data for the launching of future artificial satellites, to build and equip them with a series of very interesting instruments which will record data about Earth atmosphere, data on the condition of matter in cosmic space, and will thus pave the way to a future flight to the Moon. . . . It can now be confidently asserted that within a few years a flight to the Moon, with instruments alone in the beginning, of course, will be just as realistic as the launching of the first artificial satellite.—*K. P. Stanyukovich, Doctor of Physics and Mathematics, Moscow, October 5.*

The signals are ordinary continuous-wave telegraph signals of 0.3 seconds duration. . . .

During the I.G.Y. the Soviet Union is to launch several more bigger satellites fitted with various instruments. The present satellite is not going to return to Earth. . . . Scientists are now planning a satellite which will return to Earth. The launching of an Earth satellite is the first stage, or stepping stone, to reaching the Moon. The next stage will probably be the creation of a man-made satellite of the Moon. Such a satellite will have to be fitted with a light engine to propel it in space where there is no air to more and more remote orbits and finally to the orbit of the Moon. One solution of the problem would be an engine operating on solar energy.—*Boris Beletsky, Moscow Radio, October 5.*

At present, regular satellite observations are being conducted in the U.S.S.R. by 66 optical observation stations and 26 D.O.S.A.A.F. society clubs lavishly supplied with radio equipment. Moreover, observations are being conducted by thousands of individual radio amateurs. The scientific stations are conducting their observations with the help of radiolocators and direction finders as well as by optical methods and with the help of photography. . . .

As reported earlier, the satellite is a sphere with a diameter of 58 cm and weighing 83.6 kg. Its hermetically sealed casing is made of aluminium alloys. Its surface is polished and specially treated. The casing contains all the satellite's equipment together with a source of power for it. Before the launching, the satellite is filled with gaseous nitrogen.

Antennae in the form of four metal rods 2.4-2.9 metres long are attached to the outer surface of the satellite's casing. When the satellite is sent to its orbit, the antennae rods are folded against the rocket's body. When the satellite leaves the rocket, the antennae open out on their swivels. . . .

It should be noted that the relatively great weight of the Soviet satellite has made it possible to equip it with powerful radio transmitters ensuring reception of the satellite's signals at a great distance. . . .

The signals sent by the satellite's transmitter are in the form of telegraphic messages. . . . To register the processes taking place in the satellite, it has been equipped with sensitive elements changing the frequency of telegraphic messages and the ratios between the length of these messages and pauses with changes in some elements in the satellite such as temperature, etc. The satellite's signals are registered for subsequent decoding and analysis. . . .

The artificial Earth satellite is the first step towards the conquest of cosmic space. To proceed to manned cosmic flights it is necessary to study the effects of cosmic flight on living organisms. Such studies should be conducted, in the first instance, on animals. The Soviet Union has already sent up rockets carrying animals and will send up a satellite with animals as passengers for a detailed observation of their behaviour and the course of physiological processes.—*Article, "The Soviet-made Earth Satellite," in "Pravda," October 9.*

The launching of the artificial Earth satellite is a victory for Soviet man who, with Bolshevik boldness and clearness of purpose, determination and energy, knows how to march forward. This is a victory for collective labour, the one and only system which is capable of creating real wonders in the world—*Leading article titled "The Great Victory in the Peaceful Competition with Capitalism" in "Pravda," October 9.*

What is the ultimate aim of creating satellites? Apart from the objectives already reported—research into physical, astronomical and geophysical problems—the ultimate aim is to create near the Earth a space station from which space-ships could be launched in the future. Before, however, creating such a huge ship or satellite populated by human beings and carrying the necessary equipment for launching space-ships to other planets, one has first to study in great detail the hazards of empty space, namely the dangers from meteorites and cosmic radiation to the satellites and the living species they carry.

Apparently the first satellite will be followed by more, larger in size and carrying the more complex equipment and instruments to study the problems which have already been mentioned on many occasions. The next stage will apparently be the launching of satellites carrying animals for the study of their behaviour on the orbit; and, finally, the last stage would probably be a manned satellite. From a manned satellite it will be much easier and simpler to dispatch rockets to other planets, since a space-ship attached to a satellite will have a speed of about 8 km/ sec and will require only an additional 3-4 km/sec to overcome the field of gravity and to fly to the Moon, Mars, Venus or other planets. Everything will depend on the technical aspects of this project, the accomplishment of which is not so far off.—*Prof. Y. A. Pobedonostsev, Doctor of Technical Sciences, Moscow, October 8.*

I think it is absolutely stupendous, about the biggest thing that has happened in scientific history. Absolutely staggering.—*Prof. A. C. B. Lovell, Professor of Radio Astronomy, Manchester University, October 6.*

From a military standpoint it confronts us with a new and terrifying danger.—*Senator Russell, chairman of the Senate Foreign Relations Committee, Washington, October 6.*

Frankly, it's enough to scare hell out of me. If they can do that, they can drop ICBMs on us.—*Unidentified official concerned with Project Vanguard, October 6.*

The achievement is impressive.—*"The Times" leading article, October 7.*

The satellite is a hunk of iron almost anybody could launch.—*Rear Admiral Rawson Bennett, U.S. Chief of Naval Research, October 6.*

We congratulate Soviet scientists upon putting a satellite into orbit.—*President Eisenhower, Washington, October 9.*

We have proposed that a technical committe be set up to work out an inspection system which will assure the use of outer space for exclusively peaceful and scientific purposes.—*Mr. Cabot Lodge (U.S.A.), political committee of the United Nations General Assembly, October 10.*

In addition to "beep-beep," the satellite is now emitting signals which sound like "hm-hm" and "psst-psst."—*Reports from a number of U.S. scientists, October 10.*

FIREFLASH

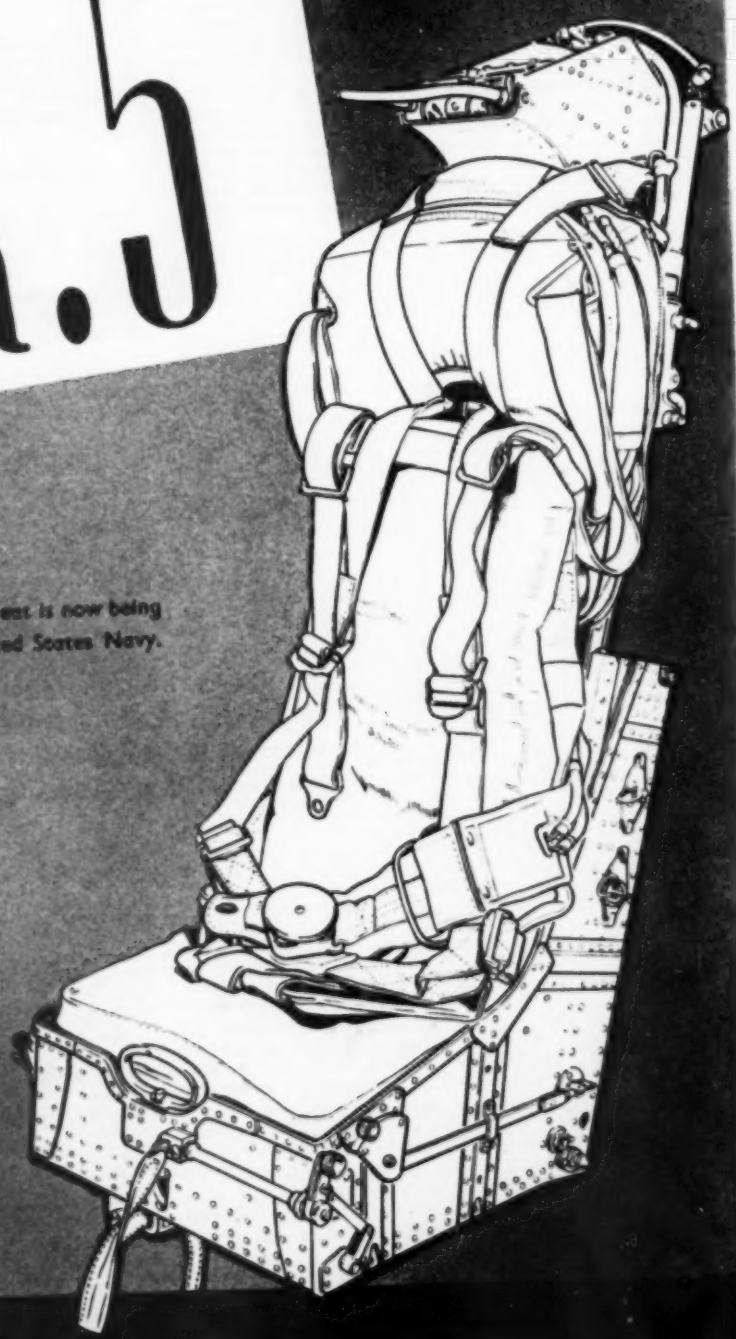
The only British air-to-air guided weapon that is in service with the R.A.F. now — proved, lethal and available.

THE FAIREY AVIATION COMPANY LTD
HAYES · MIDDLESEX

ENGLAND · AUSTRALIA · CANADA

Mk.5

The Martin-Baker Mk.5 Ejection Seat is now being delivered in quantity to the United States Navy.



MARTIN-BAKER

Aircraft Company Limited

England & Canada

Operation Longshot

Bomber Command Participation in the S.A.C. Competition

FROM October 30 and for five nights thereafter a great deal of R.A.F. and other aeronautical attention will be focused on the United States, in particular on a U.S.A.F. base called Pinecastle situated within the Florida citrus belt. It is from there that two Avro Vulcans and two Vickers Valiants representing R.A.F. Bomber Command will be taking part, with 56 Boeing B-47s and ten RB-47s of the U.S.A.F., in the Strategic Air Command bombing, navigation and reconnaissance competition. Ten B-52s and ten B-36s are also competing, operating from Carswell A.F.B., Fort Worth, Texas.

The Vulcans and Valiants form the most powerful—and the first turbojet—representation of the R.A.F. in the S.A.C. competition. In 1951 Bomber Command sent Washingtons, and in the following year Lincolns; its latest equipment has evoked admiration and respect among U.S.A.F. personnel at Pinecastle, where it is considered that the sharpest challenge to the B-47s will come not from Carswell but from Waddington and Wittering.

It was three years before the R.A.F. first participated, and two years after the S.A.C. was formed in 1946, that the annual bombing and navigation competition for the Fairchild Trophy began; and it has since then been carried out annually with the exception of 1950 when the Korean War started.

When the competition was inaugurated its purpose was avowedly pragmatic. It had been discovered that the two-year-old S.A.C.'s bombing was not so accurate as it should be; an annual competition would do much to improve skill among the newer, less-experienced crews who had succeeded the war veterans. Now, according to the former C-in-C., General Curtis Le May, S.A.C. bombs can hit not only buildings but the corners of buildings from 40,000ft; in American parlance the competition "has become a World Series for members of the S.A.C. team, who perform in the fastest air league in the world."

The 70 medium and heavy bombers competing for the Trophy this year will launch simulated attacks on targets in three city areas—Atlanta, Ga; St. Louis, Mo; and Kansas City, Mo. They then have to fly a dog-leg of approximately 1,000 miles, employing only D.R. and astro-navigation. Each aircraft will make three flights (on alternate nights), altogether being airborne for about 20 hours and covering approximately 10,000 miles. The B-52s operating out of Carswell (the B-36s from there are competing against the RB-47s in the reconnaissance contest), will be given similar target areas to attack and fly an astro- and D.R.-navigated leg of the same length. Take-offs from Pinecastle will be at approximately ten-minute intervals, as the bombing runs over the radar bomb-scoring sites will take that amount of time; and the total nightly take-off period lasts about five-and-a-half hours, to allow each aircraft sufficient hours of darkness in which to complete the navigation leg.

To qualify for an award in the bombing and navigation contests (the reconnaissance competition, for the P. T. Cullen Trophy, is limited to the RB-47s and RB-36s), a crew must complete six out of the nine bombing runs and two out of the three astro-navigation legs. For scoring purposes, a crew can take the best six out of their nine bombing runs, and two out of the three navigation legs. 750 points is the maximum which can be scored for bombing and 250 for navigation. Points are awarded on the circular error, measured in feet in the case of the bombing runs. For the main trophies, the combined total scored by two aircraft from each of the 43 S.A.C. wings and from the two Bomber Command Groups will count; but there will also be awards for individual crews. W/C.s A. D. Frank and C. C. Calder are to captain the R.A.F. Vulcans and S/L. R. N. Payne and F/L. R. Mather the Valiants.

To decide the order of first take-off for each aircraft, lots are to be drawn; second and third take-offs will be arranged so that each crew has one in the early, middle and late periods. The last involves the penalty that by the time the celestial leg is reached the stars may begin to pale; weather, of course, is an impartial hazard whatever the time of take-off. Aircraft have to operate on a strict timetable: none will be allowed to take off more than five minutes late, and the maximum time allowed behind schedule at the start of run-up to the radar scoring-site is three minutes. An umpire will fly in each aircraft to ensure adherence to rules.

Vulcan, Valiant and B-47 crews have been practising their runs over the Atlanta, St. Louis and Kansas City target areas, and will learn within a few days which of several targets in the three cities are to be their aiming points. Once that information has been given—some ten days before the competition starts—none of the competing aircraft may fly near their target areas.

The celestial leg will probably extend out into the Gulf of Mexico, where each aircraft will have to make a sharp turn (perhaps of 90 deg) and head for Tampa, its aiming point. Five minutes from there the navigator will give his E.T.A. over the city and this will be transmitted by the captain to ground control. From the moment this E.T.A. is transmitted the aircraft must stay on its heading, and its position is plotted at the time of its E.T.A. The distance of this point from the actual aiming spot will determine the aircraft's circular error.

This S.A.C. competition forms a stiff test not only for aircrews but also for those on ground, since two aircraft from each competing wing—which in the R.A.F. case means two Valiants and two Vulcans—must be kept serviceable each day. With equipment and spares limited, this means working round the clock; and for the Bomber Command crews—though most possible contingencies have been foreseen and every facility is provided at the base—special problems are involved. One of these cropped up soon after the arrival of the main R.A.F. advance party at Pinecastle, when it was found that an adaptor was needed between a hydraulic pump and a tube. The thread of the pump and tube had a British 55-deg profile, while the comparable American thread has one of 60 deg; so a pattern of the former had to be taken and an adaptor made at the base.

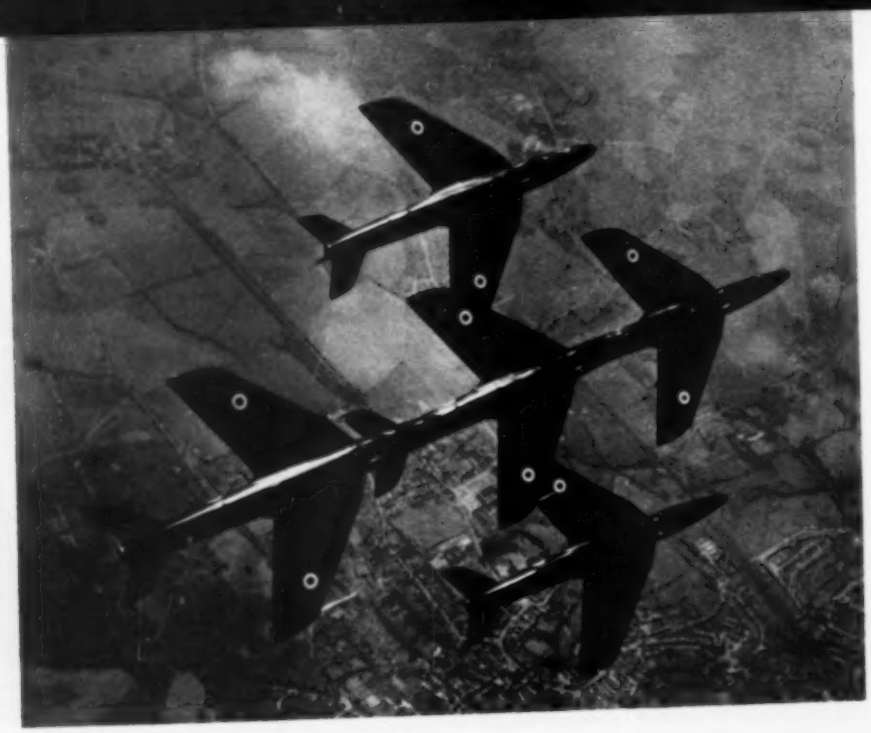
Another problem—that of towing the Valiants—had to be solved in advance by sending out from England two large Sentinel tractors; for Valiant nosewheel steering involves a 112 volt D.C. generator on the tractor and the U.S.A.F. employs power of different voltage and cycles. Altogether, 176 tons of heavy stores and equipment have been sent out from England by ship, reaching Tampa on August 24; and four Hastings of Transport Command delivered some 28,000 lb of electronic spares and equipment to Pinecastle.

Two Comets of No. 216 Squadron flew across planning officers, technicians and ground crews—the R.A.F. detachment at Pinecastle is basically a three-wing unit—from Waddington and Wittering. In the Comet which came from the latter station was G/C. John Woodroffe, so tragically killed only a few days later when on a familiarization flight in a B-47. His place as detachment commander has been taken by G/C. W. J. Burnett.

Pinecastle A.F.B., headquarters of the 321st Bombardment Wing and where the R.A.F. is based during preparation for and participation in the competition, lies seven miles from the town of Orlando, which has a population of about 130,000. The base is approximately three hours' drive from Jacksonville and from Tampa, and about 240 miles north of Miami.

Operation Longshot should prove extremely valuable in testing internationally not only our V-bombers, but also the high standards of R.A.F. peacetime training. Whatever its outcome, the journey to Pinecastle—in terms of practice and techniques—will surely have been worthwhile.

A Vulcan of No. 83 Sqn. (in heading picture) being inspected by part of the 25,000 crowd which visited Pinecastle A.F.B.'s "at home." Right, F/L. R. E. Pocock, navigator-bomb aimer on one of the Vulcans, talks to visitors about the V-bombers, whose participation in the S.A.C. competition has aroused much public interest.



Process of Perfection

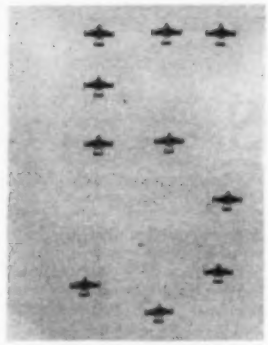
SINCE the introduction of the Hawker Hunter into R.A.F. service, Nos. 43, 54, 93 and 111 Squadrons have been among the leading exponents of formation aerobatics, commonly using four aircraft, as seen on the far left in a picture of the No. 111 Squadron team taken in 1956. It was the same squadron which first included a fifth aircraft in its full aerobatic sequence, and a "box" of five is seen in the second picture. Note that by this time (April 1957) the Hunters had been finished in their now-famous glossy-black Cellon coats. It was at the S.B.A.C. Display this year that "Treble 1" astounded all beholders by looping and rolling as a formation of nine; and a formation loop has lately been recorded (below) by the camera of M. H. Chase, M.M., F.R.P.S., of the Air Ministry. It will be seen that the Hunters' tip-trails convey a "speed-line" effect which is still a resort of some aeronautical artists. The picture was secured from the Meteor N.F.14 seen on the right, with Mr. Chase—the loftier figure—very properly conveying his thanks to his pilot, F/L. John Granville-White. At lower left the pilots of 111 Squadron are assembled: Back row, l. to r.: F/L. L. Swart, F/L. P. B. Hine, F/L. M. B. Kemp; middle row, F/O. J. M. Oakford, S/L. R. L. Topp, A.F.C. (commanding officer), F/O. R. Barcilon, F/O. M. Thurley, F/L. G. P. Aird; front row, F/O. J. A. Wheeler, F/L. D. M. Goodwin. F/L. B. E. C. Forse. "Nelson" can be discerned turning a blind eye under the bumper of the squadron jeep. (F/O. Oakford seems to have glimpsed a rival team in the middle distance; but the C.O. pays no regard. Who would, with such a bunch of bods?)

No. 5 SQUADRON

A History of the "Fighting Fifth"

By JOHN YOXALL

PART I



ON Saturday last, October 12, No. 5 Squadron was disbanded. This was no new experience, because during 44 years' existence the squadron has been disbanded and re-formed on several occasions. But this time there was a difference; for with the advent of guided missiles and pilotless aircraft it is possible that no other body of men will ever proudly belong to the "Fighting Fifth."

To mark the disbandment a parade was held, at which the squadron standard was carried. The reviewing officer was one of No. 5's most distinguished ex-members, A.V-M. H. J. Kirkpatrick, S.A.S.O. at H.Q., 2nd T.A.F., who was with the squadron when it was at Quetta in 1934. Another important visitor at the ceremony was Col. Louis Strange, whose account of the squadron's earliest days follows later in this article.

The origin of No. 5 Squadron is buried in the early days of Service flying. On April 13, 1912, the Royal Flying Corps was constituted by Royal Warrant and from then onward took over duties previously performed by the Air Battalion, Royal Engineers, which had an airship and an aeroplane company. Under the command of Major H. R. M. Brooke-Popham, the aeroplane company became No. 3 Squadron; and in August 1913 a single flight of this unit, commanded by Major J. F. A. ("Josh") Higgins, became No. 5 Squadron.

One of its pilots was Lt. G. I. Carmichael, who the previous month had accompanied Lt. R. Cholmondeley to Colchester to give demonstration and passenger flights to officers stationed in the garrison there, with the hope of interesting them in the new service.

Lt. Carmichael is now a retired group captain and for this history has kindly consulted his log book and diary and raided his photograph album. Thus he is able to give the following first-hand account of the early days of No. 5 Squadron:—

After its formation at Netheravon, No. 5 Sqn. moved to Farnborough with Maj. J. F. A. Higgins, D.S.O., Royal Artillery, in command, Capt. D. G. Conner, R.A., as flight commander, and as pilots Lts. E. V. Anderson, Black Watch; R. O. Abercrombie, R.F.C. (SR); G. I. Carmichael, R.A.; N. J. Gill, R.A.; H. F. Glanville, West India Regt.; L. C. Hordern, West African Frontier Force; F. G. Small, Connaught Rangers; R. M. Vaughan, Royal Inniskilling Fusiliers; and C. W. Wilson, Seaforths and R.F.C. (SR).

The squadron's aircraft were four Maurice Farman "Longhorns" (i.e., pusher with elevator in front) with 70 h.p. Renaults; and three Avros (50 h.p. Gnome), to which was added a Caudron (60 h.p. Anzani). Sheds and workshops were on Jersey Brow and the landing ground was mainly two straights at right angles, one running south up the hill to the buildings of Military Wing H.Q. under Lt-Col. F. H. Sykes, 15th Hussars, on the Farnborough main road, and the other running west to Laffan's Plain.

Ground and air were both rather congested because in addition to the squadron's activities periodic sorties were made from the Royal Aircraft Experimental Factory sheds, on the east side, by experimental aircraft flown by Geoffrey de Havilland and H. R. Busteed; and at uncertain times a string of Cody kites would suddenly rise swinging into the air.

In September 1913, No. 5 Sqn. with its Maurice Farmans took part in the autumn manœuvres; and early in 1914 additional officers arrived. New aircraft also came, including Sopwith two-seaters and Henri Farmans (pusher)—both with 80 h.p. Gnomes—and one S.E.2 (scout experimental), christened "the bullet" for its (alleged) speed of 100 m.p.h. In January 1914, "B" Flight was formed under Capt. E. V. Anderson and in March "C" Flight under Capt. Carmichael. Lt. A. E. Borton, Black Watch, joined the squadron in April.

Flying centred on getting familiar with new aircraft, climbing as high as possible (the Maurice Farmans took 58 minutes to 6,000ft and 1½ hours to their maximum of 7,250ft), cross-country flights to Salisbury Plain, etc., and visits to private houses.

Avros and H.F.s had disclosed most of their flaws in No. 3 Sqn. and were popular and easy to fly; but the Sopwiths, though pleasant to fly, had too many teething troubles. The simplicity of all these aircraft and of the 80 h.p. Gnome rotary seven-cylinder engine enabled squadron personnel to carry out most repairs and some modifications, overhaul engines completely, and even to rebuild some of their own crashed aircraft.

In April 1914, Capt. E. V. Anderson in a Sopwith and Lt. C. W. Wilson (with passenger) collided at 500ft over Farnborough Aerodrome. Lt. Wilson miraculously escaped with minor injuries and was cheerfully flying again after a few weeks; but the other two were killed.

On May 19, King George V inspected the R.F.C. on Jersey Brow. All the pilots were presented and afterwards flew a circuit, machines leaving the ground at one-minute intervals.

On May 28, No. 5 Sqn. moved to Netheravon for the concentration of the Military Wing at its first and last training camp before the outbreak of war. At this time it was equipped with one flight of Sopwiths and two flights of H.F.s.

Training at the Concentration Camp covered: (a) Tactical exercises, reconnaissance of areas for transport and troops, searching for a free balloon, photography with hand cameras, and changing landing grounds. It was thought that reconnaissance might reasonably be undertaken at 2,000ft. (b) Speed, climb and short landing (over a tape) tests. H.F. (without armament) figures were: speed, 59 m.p.h.; climb to 2,000ft, 7½ min, to 3,000ft, 18 min; landing over a 20ft high tape, 180 yd in a cross wind. (c) M.T. column runs (a novelty as the Army still had horsed transport). (d) Committees to work out establishments for stores and personnel.

On July 6, 1914, No. 5 Sqn. moved to Fort Grange, Gosport, where an advance party had erected portable R.E. V tents for the machines. Conditions were primitive, the landing ground was partially levelled ridge and furrow, and officers and men slept in stone gun-emplacements; but Fort Grange was No. 5's first own home and everyone was delighted.

Lt. L. C. Hordern was killed and his passenger Sgt. Campbell seriously injured when their H.F. spiralled into the ground, due (it was thought) to a seat collapsing on to the controls. At the end of July the arrival of three 80 h.p. Gnome Avros, credited with a speed of 80 m.p.h. and a climb to 3,000ft in 8 minutes, sealed the fate of the Sopwith two-seater and established the Avro in place of the Sopwith as a future war machine; but the fragility of all these aircraft—even of the Avro—was emphasized when Lt. Abercrombie did a disappearing trick on his arrival from Farnborough, sitting on the floor of his new Avro in which the seat had subsided.

Orders were received for Henri Farman controls to be moved back so that the observer could sit in front with a gun, S/Sgt. Chaney was attached to give instruction on the Vickers water-cooled and the new Lewis air-cooled machine guns, and the squadron started to mobilize on August 5, 1914.

Confident Outlook

The outlook of pilots in No. 5 might be mentioned here. It has been stated that the R.F.C. expected that the war, with flying accidents and enemy action, would result in 100 per cent pilot casualties within a few weeks, and that to conserve personnel it was ruled there must never be more than one pilot in the same machine. This may have been the Staff calculation, and the "one pilot" rule may have existed in some squadrons; but the pilots of No. 5 certainly had no such apprehension about casualties and failed to remember the "one pilot" rule even if they knew of it. And anyway Maj. Higgins himself did not observe it. How to attack enemy machines was light-heartedly discussed in the mess, and the hopeful Penn-Gaskell gave demonstrations of how he would range up alongside the enemy and loose off his machine gun; but the general atmosphere was one of exuberance and optimism. Some expected to be home again by Christmas and one officer even left all his mufti in his chest of drawers ready for his return to Gosport.

To the sombre Service types of M.T. a colourful mixture of civilian transport was added, including Sunbeam, Mercedes and Renault touring cars, a private two-seater coupé (complete with its owner, a Mr. Weeding of Guildford), a Maple van unmistakably labelled and an all-red one loudly proclaiming *The World's Appetizer*. Each flight was a self-contained unit capable of being detached with its own M.T. workshop and stores lorries, "A" Flight with four 80 h.p. Gnome Avros, and "B" and "C" each with four 80 h.p. Gnome H.F.s. Mobilization was virtually completed by the evening of August 7 and the squadron stood ready to move at short notice.

On August 12 pilots were issued with six miles to an inch maps of France and Belgium and with sealed orders as to their destination; the following day M.T. under Maj. Higgins embarked at Southampton; and on August 14 machines started *via* Shoreham and Dover for their flight across the Channel *via* Boulogne to Amiens.

Some fell by the wayside. Lt. Brock forced-landed with engine trouble ten miles north of Shoreham and Lts. Glanville and Abercrombie both crashed, the latter being concussed. Lt. C. W. Wilson, after engine trouble and having secured another engine from C.F.S., made up for lost

Seen in the heading is No. 5 Squadron's badge with its motto "Frangas non Flectas" ("Thou mayst break but not bend me"). The maple leaf signifies the unit's close association with the Canadian Army in the 1914-18 war. Up to 1937 the squadron motto was "Quintus Fructus." The other heading picture shows Venoms of the present No. 5 Squadron, led by S/L. Forgher, D.F.C., displaying their numeral in the sky.

time and was the first to land at Amiens. Lt. Borton had a broken connecting rod and forced-landed near Boulogne; he changed the engine as soon as the squadron M.T. disembarked on August 15. Lt. Vaughan had a forced landing near Senlis and was held prisoner by the French. The interplane struts of Capt. Carmichael's H.F. collapsed as he was taxying out to take off at Gosport; but he picked up a B.E.8 (known as the "Bloater") at Dover and on August 15 reached Amiens direct in 2 hr 10 min to find Capt. Grey, Lord George Wellesley and A. A. B. Thompson already there, while Lt. Borton arrived shortly afterwards.

The B.E.8 was a short-lived nasty contraption with insufficient fin surface; its petrol pressure gauge was on the pilot's dashboard but the hand pump was in the observer's compartment.

On August 16 Maj. Higgins with the squadron M.T. reached Amiens and Carmichael was sent to Buc to select three new Henri Farmans to replace casualties. By August 19 most of the pilots had caught up and No. 5 Sqn.—again nearly complete—was concentrated with Nos. 2, 3 and 4 Sqns. at Maubeuge.

On August 21, Lt. Wilson, with Rabagliati, carried out the squadron's first war reconnaissance, locating massed cavalry ten miles beyond Namur. On August 22 several reconnaissances were made (including one of the Mons area) and for the first time pilots experienced A.A. fire, which was more fascinating than dangerous with the shells bursting about 1,000ft below the machine. German rifle fire was, however, more effective that day as Lts. Waterfall and Bayly were shot down and killed.

As a result of Vaughan becoming "le petit prisonnier de Senlis," the R.F.C. was hurriedly issued with an identification ensign 12in by 8in pasted on the side of the machine, and before leaving Maubeuge on August 24 most of them had in addition a 6ft Union Jack panel painted on the under wing. The latter marking, however, looked too much like a German cross, attracted undesirable attention from all nationalities and was later replaced by the red, white and blue roundel still in use.

From Maubeuge the R.F.C. moved to Le Cateau and what was termed by No. 5 Sqn. "the strategic advance" had begun. No. 5, with Nos. 2, 3 and 4 Sqns. moved back repeatedly, keeping pace with Army H.Q. The daily procedure was reconnaissance and patrolling the rear of 1st Army, attacking enemy machines whenever possible, frequently arriving at the next landing ground at dusk and sometimes after dark, receiving verbal orders from Maj. Higgins as to work for next day.

Undoubtedly the R.F.C. contingent of the "Contemptible Little Army" led a life of comparative luxury on the ground and relative safety in the air which was a picnic compared with what was endured by troops fighting and marching on the ground; but there was never a dull moment.

On August 25 the R.F.C. moved to St. Quentin and—as an example of the impossibility of applying the "one pilot" rule—five out of six reconnaissances that day had two pilots per machine. On that day No. 5 Sqn. had its first air combat, but Lt. Glanville as observer managed to get off only nine rounds before the German triplane at 6,500ft proved its greater speed. All Henri Farmans now carried the observer in the front seat, and Penn-Gaskell invariably nursed a massive Vickers with 300 rounds of ammunition until his pilot threatened to tip him and his gun overboard because after three-quarter of an hour's hard climbing he could not get the H.F. above 3,300ft and had to complete his reconnaissance at that height. The wings, covered with doped Irish linen fabric, and never sheltered from sun and rain, began to lose their tautness and in consequence the machines their performance.

Reports were at first normally delivered at Army H.Q. but often as well direct to Corps or Div. H.Q., by landing in the vicinity of troops or by dropping messages. On August 26, Borton and Small landed and borrowed horses to deliver their report; on returning they found their machine being shelled but managed to start the engine and return safely.

German A.A., at first derided and christened by Borton "Archibald," became known to all as "Archie." Its accuracy rapidly improved. The system of ranging was at first as for targets, i.e., by salvoes, which gave opportunity for evasion by skidding sideways on an even keel after each salvo. Lt. D. S. Lewis of No. 4 Sqn. had shell splinters through his machine on August 26, and several other machines—including those of No. 5 Sqn.—were hit by shrapnel and shell splinters during the retreat.

The R.F.C. moved from St. Quentin to La Fere at 300ft in heavy rain, as a result of which some engines were difficult to start and others refused to switch off. By August 31, the R.F.C. had touched down successively at Compiègne, which was bombed by a D.F.W.; at Senlis, from which a Zeppelin was heard at night and where Rabagliati fiercely advocated (to unsympathetic listeners) attack by diving into the envelope; and at Juilly, where an experimental petrol bomb was successfully released from a Henri Farman.

On September 1, the R.F.C., still at Juilly, spent the night with only the North Irish Horse as a screen against German cavalry in the neighbourhood, and a suspect was caught prowling among No. 5's machines. The next day an early move was made to Serris, and Wilson in an Avro hopefully chased two Zeppelins northwards.

The R.F.C. moved to Pézarches on September 3 and on the 4th—for the first time—No. 5 was alloted to work with and to report direct to the 1st and 2nd Divs. Machines of "C" Flight reported to the rearguard of 1st Div. by landing at Aulnoy, later to 1st Div. H.Q. at Faremoutiers, and finally reached Melun and landed in the dark—this being the farthest south reached by the R.F.C. Sqn. in the retreat.

The Tide Turns

On September 6, "B" Flight went to Etampes to refit; but the tide of war had just turned, the "strategic advance" was now to become "advance" and the two other flights had to make the best of their opportunities for maintenance work in the open a fortnight later during the check to forward movement in the Aisne fighting.

Hitherto the weather had been generally good but it now deteriorated. The autumn gales had started, and on September 11 Abercrombie and Small were obliged to return from a reconnaissance as they were actually moving backwards at 1,600ft. On September 12, the R.F.C. moved to Fère-en-Tardenois for the Battle of the Aisne, and the high wind that night rose to gale force. Four H.F.s of No. 5 Sqn. were completely wrecked.

On September 16 began the close association between No. 5 Sqn. and III Corps—in particular with 4th Div. Artillery. Each day in turn one flight was detached to an advanced landing ground for artillery observation for 4th Div. batteries, using Very lights. By September 18 "C" Flight claimed to have located all the enemy guns on their front.

While one flight was forward working with 4th Div. the second was on maintenance redoping soggy planes, replacing frayed control cables, etc. The third flight would be engaged on reconnaissance, chasing enemy aircraft and indulging in a new form of amusement initiated by Borton and Rabagliati—attacking enemy staff cars with rifle grenades and Very lights.

The strain on aircraft continually in the open and operating from many different and uneven landing grounds had been considerable, and on September 27 an interplane strut of a Henri Farman, flown by Ware with Furze as observer, became detached at 2,500ft owing to the shearing of a bolt; but with great skill Ware brought his machine safely down. Replacements for the gale destruction now began to arrive with an Avro from England, and Maj. Higgins—having collected a Bristol scout from Juvisy—was in his element; but, unfortunately, his sight was not equal to his enthusiasm and enemy aircraft always disappeared before he could get close enough to shoot. The armament improvised on the scout was a rifle with sawn-off stock clamped to shoot diagonally forward in order to miss the propeller, and a rack of rifle grenades with the rods sawn off and replaced by streamers, from which the detonator pin usually had to be withdrawn by the pilot's teeth. [Picture, page 622.]

(Right) Inspection by King George V (at Farnborough on May 19, 1913) of the Henri Farman Flight of No. 3 Squadron, from which stemmed the nucleus of No. 5 Squadron. Left to right: Queen Mary with Gen. Sir John French; Maj. J. F. A. Higgins, Lt. R. Cholmondeley, Lt. D. L. Allen, 2nd Lt. T. O'Brien Hubbard; and King George talking to Lt. G. I. Carmichael. The picture, left, shows Lt. G. I. Carmichael demonstrating his Henri Farman at Abbey Field, Colchester, in June 1913.

The officers of the Royal Flying Corps (Military Wing) at the Concentration Camp, Netheravon, 1914. Those marked with an asterisk were members of No. 5 Sqn.

Front row: Capts. Beatty and Dawes, Majors Hon. C. Brabazon, Musgrave, Raleigh and Higgins*, Lt-Col. Sykes, Lt. Barrington-Kennett, Capts. Conner*, Cholmondeley, Herbert, Charlton and Carmichael*. 2nd row: Capts. Holt, Shephard, Grey*, Stopford, Beor, Todd, Waldron, Lts. Hynes, Mills, Joubert de la Ferté and Fuller. 3rd row: Lts. Smith, Christie, Stodart*, Rodwell, James, Spence, Mansfield, Humphreys, Gould, Mitchell, Cogan, R. G. D. Small, Allen and Pryce. 4th row: Lts. Penn-Gaskell*, Dawes, Martyn, Vaughan*, Birch, Read, Adams*, Barton*, Corballis and Mapplebeck. 5th row: Harvey-Kelly, Freeman, McNeece, Glanville*, Noel, Wadham, Porter, Playfair, Hubbard, Lewis, Morgan, and F. G. Small*. 6th row: Lts. Mansergh, Carpenter, Shekleton, Atkinson, Hartree, Moore, Hoskins, Waterfall*, Lywood and Hordern.

NO. 5 SQUADRON . . .

On October 7 the flank movement northwards started, the R.F.C. flew to Abbeville, many reconnaissances were done in spite of fog, low cloud and rain, and by October 12 Nos. 3, 4 and 5 Sqns. were assembled at St. Omer.

On October 14 "C" Flight was detached to work direct in the forward area with the 4th and 6th Divs. of III Corps, and moving successively to Wallon Cappel and Meteren arrived at Bailleul on October 18.

Borton with Capt. J. R. Campbell Heathcote, Cameron Highlanders (who had joined No. 5 Sqn. at Fere-en-Tardenois as an observer), damaged his H.F. when landing at Bethuen on October 15 to deliver a reconnaissance report to Gen. Allenby. He managed to find "C" Flight in the dark at Wallon Cappel, collected the requisite spares and after spending two nights under his machine completed repairs and with his engine fitter Hill rejoined the flight.

On October 23 "C" Flight—relieved by "A" and "B"—returned to St. Omer to refit and for the first time since arriving in France the machines were housed under cover in portable tents. These tents were, however, an anxiety in the high winds, and two nights later all machines were hauled out and picketed down in the open behind a screen of lorries.

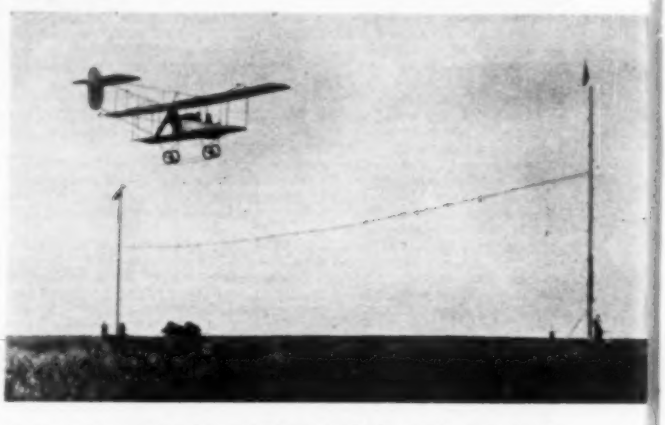
Maj. Higgins was wounded by a rifle bullet in the thigh when out on October 30 with Vaughan, who two days later followed suit with shrapnel in his leg. Carmichael and Heathcote, after dropping rifle grenades on a "sausage" balloon without any effect, had a broken connecting rod and glided back over our lines. But they wrecked the Avro in a hop field and were nearly lynched by Belgians who failed to discern either the small ensign or the Union Jack markings in the debris.

On November 18 Maj. A. C. H. MacLean took over command of No. 5 Sqn. from Maj. Higgins and was greeted by a Taube bomb attack on Bailleul landing ground, followed by heavy storms which one night covered with 1½in of snow the wings of the machines still picketed out.

After the H.F.s could no longer carry the extra weight of a machine gun, the persistent Penn-Gaskell with L. A. Strange devised a Lewis gun mounting for an Avro. This simple affair consisted of a cross-bar between the centre section struts, over which a rope was slung to haul up the Lewis so that it could be fired backwards over the head of the pilot. All the pilot had to do was to place his Avro below and in front of the target. The reward of Penn-Gaskell's zeal, however, went to Small as observer with Strange on November 22, when in a duel with an Aviatik the Lewis soon persuaded the owner of the Mauser pistol and coloured lights that the ground was safer than the air. The Aviatik landed near Bailleul with plenty of holes in it, but the two Germans who then surrendered had been hit only by anticipation.

The H.F. was rather too tempting a target homing against the strong westerly winds which at times forced them to struggle along slowly at very low heights, and on several occasions reconnaissance had to be cancelled because they were actually moving backwards at heights between 2,000 and 3,000ft. It was then that the scouts allotted to No. 5 Sqn. were particularly useful. A succession of these included the S.E.2, Bristol Bullet, Sopwith Tabloid and Martinsyde "four wheeler" —all with 80 h.p. Gnome engines. The Tabloid was a joy to fly but the Martinsyde was the most robust—even surviving a somersault over a surprised Belgian wheelbarrow with damage only to centre section and rudder.

During this period new officers arrived, and instruction in artillery observation was given not only to squadron members but also to visitors from the artillery divisions. A model landscape was used consisting of a blanket with toy targets and cottonwool puffs, which developed later into the highly realistic painted models at the School of Army Co-op.



A No. 5 Sqn. Henri Farman "short landing" over a tape at the Netheravon Concentration Camp, 1914.

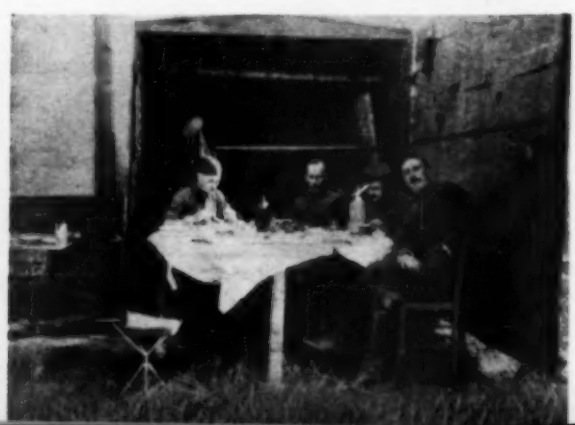
The Very light system for directing artillery fire was primitive and slow but effective. In December the Aldis lamp was used for the first time by Harbord and Johnstone; it was quicker than Very lights but required more accurate flying to enable the observer to focus the beam on the battery signallers.

On December 2 No. 5 Sqn. was inspected at Bailleul by King George V, accompanied by the Prince of Wales, all officers being

(Right) Maj. G. I. Carmichael (now G/C., retd.) was one of the original members of No. 5 Sqn. and has contributed to this history.

(Below, left) A hitherto unpublished photograph of the R.F.C. in the field during the retreat from Mons, with No. 5 Sqn. Henri Farmans in the background. Lts. Wilson and Rabagliati write reports, Maj. Higgins rubs tobacco, Lt. Furze prefers a more earthly seat and Capt. Conner, right, surveys the scene.

(Below) Compiègne airfield during the retreat. An open aeroplane-case door provides protection for the "mess." L. to r.: Lt. Rabagliati, Lt. Wilson, Capt. Conner and Maj. Higgins.



Capt. Carmichael's flight at lunch In the background are some of the Crossley tenders with which the R.F.C. were equipped during the 1914-18 war.

presented; and during that month No. 5 Sqn. started photographic reconnaissance with a fixed box camera. By the end of January 1915 this method was proving invaluable both to the gunners and the infantry.

The R.F.C. Air Committee gift hampers, full of good things, and one of Princess Mary's gilt chocolate boxes for every officer and man, arrived and were issued in time for Christmas Day, which was celebrated traditionally—with an added touch by Strange who flew low over Lille Aerodrome to drop a football which bounced among the astonished Germans.

The conditions under which the R.F.C. operated during the 1914-15 winter were paradisal compared with what men endured in the open, waterlogged trenches. It would, however, be misleading not to mention some of the disastrous effects of weather and terrain on the fortunes of No. 5 Sqn. Early in December, continuous storms turned the Bailleul landing ground into a swamp and another was found N.E. of the town. Here the ground was dry, but flying off in a N.W. wind necessitated climbing over houses on rising ground. The majority of the machines were never under cover but constantly exposed to the weather. Sometimes it was only possible to take off if the observer was left behind. Even so, Rabagliati in an Avro failed to rise and smashed his undercarriage. An H.F., after taking 20 minutes to reach 2,300ft, was opened up to disclose the rear spar soaked and sprouting green fungus. Both the magneto and carburettor of the rotary 80 h.p. Gnome engine as mounted in the H.F. were exposed to the elements in flight, and although covered up at night could not escape the effects of damp. It was not uncommon for the carburettor to build up a layer of frozen moisture, causing loss of revs.

During January 1915, Lt. D. S. Lewis, R.E., was attached to No. 5 Sqn. to initiate artillery observation by W/T. He and Lt. B. T. James, R.E., ever since joining the R.F.C., had persistently advocated the use of, and experimented with, W/T; and they had evolved the "clock code" method of signalling the fall of a shell. Both these officers were enthusiasts to the end of their careers. James was killed when his tail was shot off by A.A., and Lewis was killed by A.A. when he was commanding a Wing.

Early Interdiction

Early in March Nos. 5 and 6 Sqns. were detailed for the first serious attempt made by the R.F.C. to disrupt enemy communications by bombing. When it became "hush hush" knowledge in No. 5 Sqn. that a real "egg" was to be delivered there was some competition for the privilege. The number of enthusiasts was reduced, however, by the C.O.'s firm decision that the Martinsyde should be used; and there were only three pilots who could justifiably claim ownership. Of these, Wilson was rudely eliminated by the argument that he already carried 100 lb more than anyone else even without a bomb, and Carmichael finally won the toss from a disappointed Rabagliati. On the day of the Neuve Chapelle battle the railways of Courtrai and Menin were successfully attacked from low altitudes respectively by Strange (now with No. 6 Sqn. as flight commander) with four 20 lb bombs and by Carmichael of No. 5 with a single 100-pounder sighted through a hole cut in the floor. The Martinsyde again proved its robustness, getting back safely with one cylinder out of action, the lateral controls and a bracing wire cut, the top of the tank and struts hit, and several holes in wings and fuselage. [G/C. Carmichael omits to mention that he bombed from as low as 120ft and also that for this effort he was awarded the D.S.O.]

The personnel pattern of No. 5 was gradually changing. Of the original partnership in "C" Flight, for example, Lt. Borton had gone home in November 1914 on promotion, to return later in command of No. 27 Sqn. (the fore and aft gun Elephants); Lt. Brock likewise had left in January 1915 to return in command of No. 15 Sqn.; and Capt. Carmichael (replaced by Capt. D. S. R. Crosbie, Argyll and Sutherland Highlanders) left in March to raise No. 18 Sqn. Heathcote, Glanville and Penn-Gaskell had all returned to U.K.

With the loss of Ware and Furze, "C" Flight in seven months of war lost only one pilot and one observer of the originals, and these were casualties through flying accidents.

Another officer who joined No. 5 practically at its birth was 2nd Lt. (now Lt-Col.) C. W. Wilson. He, too, flew to France with the unit, watching the Battle of Mons from the air and, later, the slow formation of the shell-pocked line across northern France. His story of the early days also makes fascinating reading, and his photographs taken during the retreat from Mons have not hitherto been published. He writes:—

I joined No. 5 Squadron at Farnborough in 1913 as a 2nd Lt., R.F.C. reserve, for continuous service, and my first job was to conduct a small party of mechanics from Farnborough to Rugby for the 1913 manœuvres.

The maternity jacket with wings was practically unknown in London, and during a very long walk from Waterloo to Paddington we heard a large number of suggestions as to where we had come from. I was very lucky at Rugby, doing two reconnaissances of the British Army with fair accuracy. As the positions of all troops and composition of columns could be checked by the staff, this was a very interesting and valuable experience, and on the last day Maj. Higgins gave me an outline of a report to drop in a message bag at a certain spot by map reference. By a most extraordinary fluke this message bag fluttered down within a few yards of King George V, who was watching the concentrated finale of the manœuvres. Col. Sykes enjoyed this tremendously.

During the 1913-14 winter No. 5 was getting organized into three flights, and officers who were not flight commanders were given charge of stores, workshops and transport for ground work, as well as fetching unwanted machines from older squadrons. I was O.C. transport, and flew a 50 h.p. Avro from No. 3 on Salisbury Plain. I remember Stodart having a "forced landing" in a Maurice Farman at Roedean *en route* to Eastbourne. His companions refused to accept his statement that there was anything "forced" about it.

We taught our own mechanics to drive lorries and tenders and ride motor cycles, many of the "fitters" requiring little teaching. On our practice mobilization the transport was sent for a drive round Aldershot and back to Farnborough, some of the inspecting staff having a suspicion that there might be a few dummies. However, the drive was a success. We had a most efficient Sgt. Bullen, who I am glad to say finished the war with a commission and in command of the R.F.C. workshops at Rouen.

On the Way to War

No. 5 very much enjoyed its first home at Fort Grange and were beginning to know each other when war began to loom on the horizon. I was sent to Farnborough to take over the first 80 h.p. Avro, No. 398, and remember that I realized at once on the way to Fort Grange what a wonderful machine it was. I begged Maj. Higgins to let "A" Flight have it, and it became my mount for the first eight months of the war. We had a magnificent view of the Grand Fleet in the Solent from the air, and also of the B.E.F. marching to Southampton and sailing for France.

As G/C. Carmichael relates, the pilots of No. 5 had rather a weird variety of experiences on the way to war, my own contribution being an engine failure before leaving the aerodrome, so that 398 was a good last to leave Fort Grange. However, the Central Flying School sent me an engine and a gang of mechanics to put it in, and I made a clean trip to Amiens next day, arriving first of those who started from Fort Grange. Avro 398 was astonishingly lucky to be given no less than three reconnaissances from Maubeuge—one of them over the actual battle of Mons.

No. 5 was actually on the left of the R.F.C. and from the start we were given sectors roughly triangular to reconnoitre on the left (or west) of our front. These reconnaissances were only of negative value as my allotted route held no troops in numbers; but I understood it was important to know that there was no body of troops on our Tournai side. I located a large body of cavalry at Buiche, or rather north of Buiche; but this was rather outside my sector. Of course I made nothing of the Battle of Mons—except that it was a battle. The very large concentration of shrapnel bursts (white) over a wide area was clear enough, but no pilot could possibly make an accurate report on deployed troops. On August 2 the R.F.C. left Maubeuge for Le Cateau, the start of the great retreat. My log shows 30 minutes by air to Le Cateau. On the 25th I returned from a long reconnaissance—as before, on the west of the retreating B.E.F.—and shortly after landing a Taube was seen coming from the south. Maj. Higgins instantly gave the order: "There you are, Wilson. Go and take his number." I was off the mark at once, but Rabagliati scrambled on board 398 before me with a rifle and ammunition. We headed north, climbing, R. kneeling on his seat in front and steering me till we got into position—ahead and below as we

Reconnaissance report of Lts. Waterfall and Bayly, who were flying the first R.F.C. aircraft which failed to return. The report was found and passed on by Belgian peasants.

The officers of the Royal Flying Corps (Military Wing) at the Concentration Camp, Netheravon, 1914. Those marked with an asterisk were members of No. 5 Sqn.

Front row: Capts. Beatty and Dawes, Majors Hon. C. Brabazon, Musgrave, Raleigh and Higgins*, Lt-Col. Sykes, Lt. Barrington-Kennett, Capts. Conner*, Cholmondeley, Herbert, Charlton and Carmichael*. 2nd row: Capts. Holt, Shephard, Grey*, Stopford, Beur, Todd, Waldron, Lts. Hynes, Mills, Joubert de la Ferté and Fuller. 3rd row: Lts. Smith, Christie, Stodart*, Rodwell, James, Spence, Mansfield, Humphreys, Gould, Mitchell, Cogan, R. G. D. Small, Allen and Pryce. 4th row: Lts. Penn-Gaskell*, Dawes, Martyn, Vaughan*, Birch, Read, Adams*, Barton*, Corballis and Mapplebeck. 5th row: Harvey-Kelly, Freeman, McNeece, Glanville*, Noel, Wadham, Porter, Playfair, Hubbard, Lewis, Morgan, and F. G. Small*. 6th row: Lts. Mansergh, Carpenter, Shekleton, Atkinson, Hartree, Moore, Hoskins, Waterfall*, Lywood and Hordern.

NO. 5 SQUADRON . . .

On October 7 the flank movement northwards started, the R.F.C. flew to Abbeville, many reconnaissances were done in spite of fog, low cloud and rain, and by October 12 Nos. 3, 4 and 5 Sqns. were assembled at St. Omer.

On October 14 "C" Flight was detached to work direct in the forward area with the 4th and 6th Divs. of III Corps, and moving successively to Wallon Cappel and Meteren arrived at Bailleul on October 18.

Borton with Capt. J. R. Campbell Heathcote, Cameron Highlanders (who had joined No. 5 Sqn. at Fere-en-Tardenois as an observer), damaged his H.F. when landing at Bethuen on October 15 to deliver a reconnaissance report to Gen. Allenby. He managed to find "C" Flight in the dark at Wallon Cappel, collected the requisite spares and after spending two nights under his machine completed repairs and with his engine fitter Hill rejoined the flight.

On October 23 "C" Flight—relieved by "A" and "B"—returned to St. Omer to refit and for the first time since arriving in France the machines were housed under cover in portable tents. These tents were, however, an anxiety in the high winds, and two nights later all machines were hauled out and picketed down in the open behind a screen of lorries.

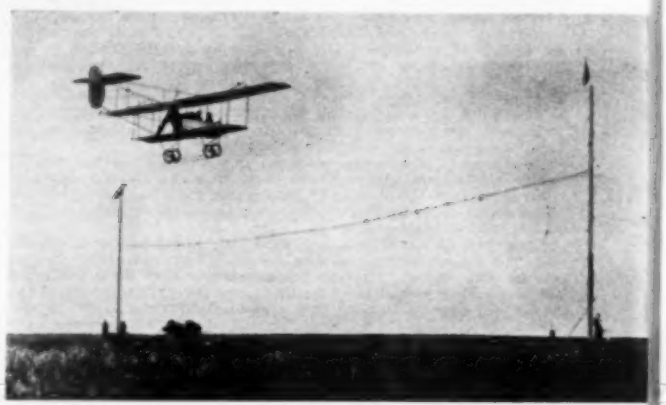
Maj. Higgins was wounded by a rifle bullet in the thigh when out on October 30 with Vaughan, who two days later followed suit with shrapnel in his leg. Carmichael and Heathcote, after dropping rifle grenades on a "sausage" balloon without any effect, had a broken connecting rod and glided back over our lines. But they wrecked the Avro in a hop field and were nearly lynched by Belgians who failed to discern either the small ensign or the Union Jack markings in the debris.

On November 18 Maj. A. C. H. MacLean took over command of No. 5 Sqn. from Maj. Higgins and was greeted by a Taube bomb attack on Bailleul landing ground, followed by heavy storms which one night covered with 1½in of snow the wings of the machines still picketed out.

After the H.F.s could no longer carry the extra weight of a machine gun, the persistent Penn-Gaskell with L. A. Strange devised a Lewis gun mounting for an Avro. This simple affair consisted of a cross-bar between the centre section struts, over which a rope was slung to haul up the Lewis so that it could be fired backwards over the head of the pilot. All the pilot had to do was to place his Avro below and in front of the target. The reward of Penn-Gaskell's zeal, however, went to Small as observer with Strange on November 22, when in a duel with an Aviatik the Lewis soon persuaded the owner of the Mauser pistol and coloured lights that the ground was safer than the air. The Aviatik landed near Bailleul with plenty of holes in it, but the two Germans who then surrendered had been hit only by anticipation.

The H.F. was rather too tempting a target homing against the strong westerly winds which at times forced them to struggle along slowly at very low heights, and on several occasions reconnaissance had to be cancelled because they were actually moving backwards at heights between 2,000 and 3,000ft. It was then that the scouts allotted to No. 5 Sqn. were particularly useful. A succession of these included the S.E.2, Bristol Bullet, Sopwith Tabloid and Martinsyde "four wheeler" —all with 80 h.p. Gnome engines. The Tabloid was a joy to fly but the Martinsyde was the most robust—even surviving a somersault over a surprised Belgian wheelbarrow with damage only to centre section and rudder.

During this period new officers arrived, and instruction in artillery observation was given not only to squadron members but also to visitors from the artillery divisions. A model landscape was used consisting of a blanket with toy targets and cottonwool puffs, which developed later into the highly realistic painted models at the School of Army Co-op.



A No. 5 Sqn. Henri Farman "short landing" over a tape at the Netheravon Concentration Camp, 1914.

The Very light system for directing artillery fire was primitive and slow but effective. In December the Aldis lamp was used for the first time by Harbord and Johnstone; it was quicker than Very lights but required more accurate flying to enable the observer to focus the beam on the battery signallers.

On December 2 No. 5 Sqn. was inspected at Bailleul by King George V, accompanied by the Prince of Wales, all officers being

(Right) Maj. G. I. Carmichael (now G/C., retd.) was one of the original members of No. 5 Sqn. and has contributed to this history.

(Below, left) A hitherto unpublished photograph of the R.F.C. in the field during the retreat from Mons, with No. 5 Sqn. Henri Farmans in the background. Lts. Wilson and Rabagliati write reports, Maj. Higgins rests, tobacco, Lt. Furze prefers a more earthy [illegible] and Capt. Conner, right, surveys the [illegible]

(Below) Compiègne airfield during the [illegible] An open aeroplane-case door provides protection for the "mess." L. to r.: Lt. Rabagliati, Lt. Wilson, Capt. Conner and Maj. Higgins.

Capt. Carmichael's flight at lunch In the background are some of the Crossley tenders with which the R.F.C. were equipped during the 1914-18 war.

his photographs taken during the retreat from Mons have not hitherto been published. He writes:—

I joined No. 5 Squadron at Farnborough in 1913 as a 2nd Lt., R.F.C. reserve, for continuous service, and my first job was to conduct a small party of mechanics from Farnborough to Rugby for the 1913 manœuvres.

The maternity jacket with wings was practically unknown in London, and during a very long walk from Waterloo to Paddington we heard a large number of suggestions as to where we had come from. I was very lucky at Rugby, doing two reconnaissances of the British Army with fair accuracy. As the positions of all troops and composition of columns could be checked by the staff, this was a very interesting and valuable experience, and on the last day Maj. Higgins gave me an outline of a report to drop in a message bag at a certain spot by map reference. By a most extraordinary fluke this message bag fluttered down within a few yards of King George V, who was watching the concentrated finale of the manœuvres. Col. Sykes enjoyed this tremendously.

During the 1913-14 winter No. 5 was getting organized into three flights, and officers who were not flight commanders were given charge of stores, workshops and transport for ground work, as well as fetching unwanted machines from older squadrons. I was O.C. transport, and flew a 50 h.p. Avro from No. 3 on Salisbury Plain. I remember Stodart having a "forced landing" in a Maurice Farman at Roedean *en route* to Eastbourne. His companions refused to accept his statement that there was anything "forced" about it.

We taught our own mechanics to drive lorries and tenders and ride motor cycles, many of the "fitters" requiring little teaching. On our practice mobilization the transport was sent for a drive round Aldershot and back to Farnborough, some of the inspecting staff having a suspicion that there might be a few dummies. However, the drive was a success. We had a most efficient Sgt. Bullen, who I am glad to say finished the war with a commission and in command of the R.F.C. workshops at Rouen.

On the Way to War

No. 5 very much enjoyed its first home at Fort Grange and were beginning to know each other when war began to loom on the horizon. I was sent to [illegible] to take over the first 80 h.p. Avro, No. 398, and [illegible] on the way to Fort Grange what a [illegible] Higgins to let "A" Flight [illegible] months of the war. [illegible] the Solent from the [illegible] and sailing for [illegible]

[illegible] rather a weird [illegible] mission being [illegible] as a good [illegible] sent me [illegible] ean trip [illegible] Grange. [illegible] recon- [illegible] ans. [illegible] we [illegible]

NO. 5 SQUADRON . . .

always meant to do. He then began firing and ejecting his empties into my face, cursing at the lack of result. Suddenly his face lit up and waving his rifle in the air he pointed to the earth.

Dodging the rifle I swung over and dived, nearly leaving R. behind. I soon spotted the German and then my attention was caught by a long column of troops on the march, coming south. The German landed safely, not far from the column. I thought: German troops, of course. I can't land. Better go home. So I turned south and soon found Le Cateau again. Maj. H. sent us to H.Q., R.F.C. and I told Col. Sykes about the column of troops. It was part of the B.E.F. in full retreat. We were credited with the *first* German machine in the official history of the R.F.C.

The R.F.C. continued retresting and advancing for reconnaissances. My log has at Senlis an interesting note (31.8.14) that a move was expected of our overseas base (B.E.F.) from Havre to Nantes. On 4.9.14 I flew from Pezarches to Melun, doing the usual reconnaissance north before leaving. On this flight I reported what I thought was a changed direction of German columns moving more to the east, and my sector emptier than ever. On 5.9.14 I was sent rather late in the evening with Furze to confirm and enlarge on the reconnaissance of 4.9.14. This reconnaissance was the most interesting we had, and the last I did during the retreat. We definitely confirmed the changed direction. Furze had not been on the first reconnaissance; I had taken my mechanic as we were changing landing grounds. We spent a long time on this job. Furze was very excited and I had our only compass—a poor one at that—and had to signal to him. I suddenly realized that it was getting dark and we were a good bit north of Melun at 5,000ft—which meant that it was much darker on the ground. We got back to Melun and landed by flares in the pitch darkness.

From Retreat to Advance

Furze and I were both sent to French's headquarters direct, and had a long interview with his staff. The B.E.F. went into reverse the next day, and the Germans were eventually driven back to the Aisne after the Battle of the Marne. We afterwards knew that we had seen the famous turn of Von Kluck's Army away from Paris, which cost the Germans the war.

On 6.9.14 I was sent with three other pilots of No. 5—Wellesley, Ware and Creed—to Etampes to rest and refit our machines. At Etampes we saw the "flight from Paris" by the civilian population—a curious experience, as we knew it was then quite unnecessary. At Etampes my mechanic, who adored 398, pinched a drum of boat varnish and varnished it all over—an excellent idea. I handed over 398 in April 1915 in good order, having only seen a shed occasionally.

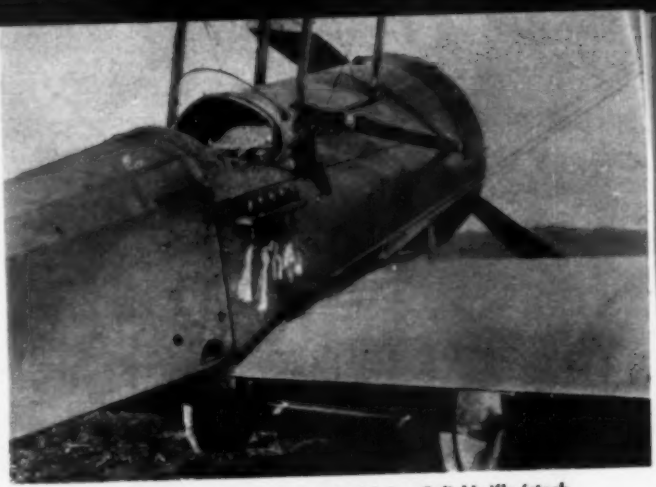
We returned to No. 5 at Coulommiers on 12.9.14, finding to our surprise that both No. 5 and the B.E.F. had got along quite well and even won the Battle of the Marne without us. The retreat from Mons was well over and occasionally I have been ashamed at our enjoyment of it. But not while it was on—we had all the luck. A gay picnic in lovely summer weather, moving almost every day, sleeping under your aeroplane or in a barn, or in a splendid chateau.

Our main meal was lunch in fields or sheds, our rations supplemented by French wine, and often by éclairs and gateaux and omelettes. Flight Crossley tenders made useful shopping possible always.

The young R.F.C. had had a supreme test in action in a war of movement, and was pining to advance and develop ideas of fighting, co-operation with artillery, bombing, photography, wireless, etc.—ideas it knew were bound to come.

A pre-1914 demonstration pilot and member of the sixth course of C.F.S., 2nd Lt. (now Col.) L. A. Strange is yet a third original member of No. 5 Squadron who has been kind enough to recall its early days. Incidentally, it will be remembered that Louis Strange also played an important part in the 1939-45 war—still flying and engaged in training paratroops. He writes:—

There was much excitement at Upavon, where the sixth course of instruction was ending at the Central Flying School in July 1914. Capt. Godfrey Paine assembled us all in the lecture room and told us that all those on the course who were considered fit and sufficiently advanced in flying were to be posted to active service squadrons forthwith. To my great joy I was one of these, and hurriedly packing our kit we went off to report at R.F.C. headquarters at Farnborough. But I did not stay there long for I was promptly posted to No. 5 Squadron, located at Fort Grange, Gosport.



1914 armament: A Bristol Scout equipped with Lee-Enfield rifle (stock sawn off), Mauser pistol and rifle grenades. The rods have been removed from the grenades, and rags substituted to serve as tails.

I do not think I ever worked so hard or so long as during those first few days with the squadron. It was one continual bustle to get our stores listed and packed, and there appeared to be every indication of our going overseas as a complete unit. No. 5 Squadron, under Maj. J. F. A. Higgins, had not long been formed and was short of many things. Our lorries were a miscellaneous collection of vehicles requisitioned from various commercial organizations. The H.Q. stores lorry was a huge red covered van with *A. 1 Sauce, the World's Appetizer* painted in large black letters on it. This became a welcome object later on and was easily spotted from the air.

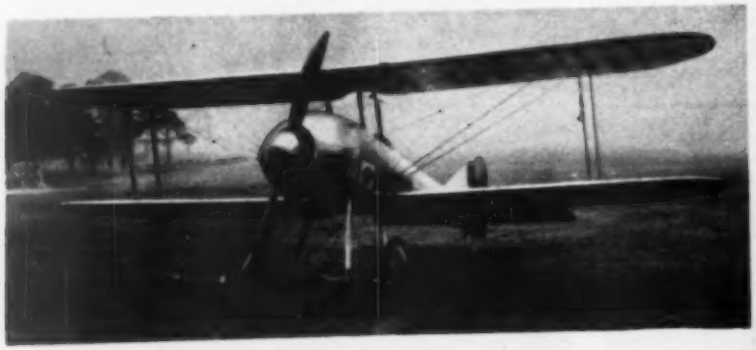
We were short of aircraft, and my first job was to fly an unwanted 50 h.p. Gnome Avro back to C.F.S. and to return with an 80 h.p. Henri Farman. I took it to Netheravon first to have a compass fitted and swung, and then I had a forced landing at Over Wallop but got back all right. Capt. Carmichael was my flight commander. Robert Smith-Barry (of later Gosport fame) was a pilot officer in one of the other flights. At last everything was ready; aircraft, lorries, mechanics and pilots only waited the word to move off—and on August 14, just a fortnight after I joined the squadron, the transport departed with the aircraft following the next morning. We flew independently to Dover and landed on the downs just above the castle, having had to land at Shoreham to fill up, as we had a strong head wind. I broke a tail skid taxying over a ditch and had to go to Farnborough to get another, which made me a day late. I flew over on Sunday, August 16, to France and landed at Amiens, where I found eight other aircraft of No. 5 had arrived. It took me 45 minutes to cross the Channel against a strong north-east head wind.

On August 19 we moved up to Maubeuge and from there did our first reconnaissance flights. On the 22nd the first German aeroplane flew over our aerodrome, and Lt. Penn-Gaskell and I took off after it, ours being the only machine fitted with a Lewis gun in the front seat; but we could not get over 3,500ft with the Taube sailing along at about 5,000ft. We shot off all our ammunition, but without effect. After this I had to go without the Lewis gun and take a rifle instead in order to climb higher.

It was not until I got an 80 h.p. Avro that I was able to get my Lewis gun back, when with Lt. Small we shot down an Aviatik. This machine landed almost intact and was later flown back to Farnborough. That day, No. 5 had its first casualties, when Lts. Bayly and Waterfall failed to return from reconnaissance. (The report written by Lt. Bayly was found by a Belgian and eventually arrived at the War Office.)

No. 5 was lucky to have one flight of Avros, one of Henri Farmans and one of B.E.8s. The B.E.8s were not very satisfactory and were soon replaced. The Avros had by far the best performance and eventually we were entirely equipped with them. My Henri Farman, however, did over 340 hours' flying during the first five months of the

(Left) The S.E.2 which No. 5 Sqn. proudly owned for a time early in the 1914-18 war. (Centre) Louis Strange, who served with No. 5 Sqn. as a second lieutenant in 1914. He is seen here as a demonstration pilot at Hendon in 1913. (Right) G/C. J. G. Hearson, who, as a major, took over command of the squadron on December 21, 1915.



Now adopted by the Royal Air Force

JET Provost

The only jet trainer in the world to have been accepted for ab initio and basic military flying training.

Powered by one Armstrong Siddeley Viper Turbo-jet.

HUNTING PERCIVAL AIRCRAFT LTD

A Hunting Group Company

LUTON, BEDFORDSHIRE, ENGLAND and at 1450 O'CONNOR DRIVE, TORONTO, CANADA

DON'T TAKE CHANCES

—by asking just for 'oil'

Your garage man can't guess what you want. That is why you should ask for Castrol by name. Always insist on Castrol, the Masterpiece in Oils, both on the forecourt and in the service bay.

ask for

CASTROL

by name

Part of the R.A.F. component of the Army of the Rhine: No. 5 Sqn. in May 1919—a phase of the squadron's history that will be dealt with in the next instalment of this article. The C.O. in the centre is Maj. D. F. Stevenson.

No. 5 SQUADRON . . .

war and was never under cover. (We were lucky to have a canvas hangar for our engine overhauls.)

On August 24, shells fell close to our aerodrome as the Battle of Mons drew to a close, and the famous retreat was about to start. That day we flew back, after doing our reconnaissance to Le Cateau. The last I saw of Maubeuge was a Henri Farman being burnt to prevent it falling into enemy hands. For the next fortnight we seldom had any billets, but slept in greatcoats under our machines. When I returned from my dawn reconnaissance to the field that was our aerodrome at Le Cateau I could see no sign of aircraft or transport, but a fierce battle was being fought. The only thing to do was to fly south and look for our famous van, which I soon found. Landing by the roadside in a field I handed in my report when the van came by. I filled up from the petrol wagon, then was sent off on another reconnaissance and told to look for a field near St. Quentin. There we landed in a wheat field, which was easy to find as the stooks had been put aside to make an L-shaped aerodrome. The sheaves, with others stacked round the bottom plane, made good beds, and we were very comfortable that night. We lived almost entirely on bully beef, biscuits and chocolate, and plenty of fruit from the countryside.

August 27 was a particularly anxious time with the Germans continually working round our flanks. Shells soon landed close and a hasty take-off late next day took us back to La Fère. August 28, messenger all day, with Capt. Bonham Carter as observer. This meant taking messages to all sorts of odd divisional and brigade headquarters, and landing in any field that looked possible. We landed back that night at Compiègne on the race-course. August 29, dropped two petrol bombs on German transport north of St. Quentin from 500ft. That same evening a German machine dropped three bombs close to the aerodrome. I believe Norman Spratt, in a Sopwith Tabloid, brought this aircraft down. Gordon Bell also flew a single-seater, a Bristol Scout. No one but first-class pilots could have put these very lightly-constructed aircraft down without damage on some of the fields we used. From Compiègne we moved back first to Senlis, then to Juilly, and then Pezarches and finally Melun. From there, when the Battle of the Marne had been won, back north to Coulommiers.

Aircraft Serviceability in 1915

My Henri Farman had done just over 50 hours' flying in about three weeks. This does not sound much now, but then that meant up to 9 or 10 flights a day in and out of any kind of field that looked suitable. Actually, she did nearly 400 hours in No. 5 Sqn. before she was at last wrecked (in a cemetery). When we did artillery observation we used to land after each shoot as close as we could to the battery we were working with, and the observer, who was always a gunner on these occasions, would go to the battery and explain the results of each shoot. Once, with Capt. Furze, I did 16 such flights in one day. During this period, fighting in the air was very rare and usually accidental. Our job was reconnaissance and this was of first importance. The machines on either side were so few that to meet in the air was unlikely, and with all eyes on the ground and no fear of air attack, we were not likely to see the odd one that might have been in sight. On September 12 I got six bullet holes in my machine and a king-post shot away. This did not affect the machine in flight, but the top plane extension fell down when I landed in a field to hand a report in to General Pultenay, commanding III Corps, near Ville Montoire; and I had to stay there that night. I was fortunate to find good shelter behind some corn ricks, for a great gale sprang up and nearly all the aircraft on the main R.F.C. aerodrome at Fère-en-Tardenois were wrecked. So for once on active service No. 5 was the only squadron to have any aircraft flying.

One day, when the A.A. fire seemed heavier than usual, I was made prisoner on landing by French gunners, who claimed to have shot me down. I was surprised, but had the presence of mind to ask them politely to stop practising on me, as I thought they were now good enough.

After so much moving around and fresh sights, the Battle of the Aisne seemed rather monotonous. We noticed, however, that the line of trenches was gradually extending west and north, and were not sorry to get orders to move to Abbeville (October 15), and from there to St. Omer (Oct. 20), where we worked for the 7th Division under Gen. Rawlinson. No. 5 Sqn. did a great deal of flying during the first Battle of Ypres and a very anxious time it was. Our C.O., Maj. Higgins, was wounded and replaced by Maj. A. C. H. McLean, as also were Lt. Borton (later Air Marshal "Biffy" Borton) and Lt. Small. He was wounded in my machine, a new Avro in which we had just mounted a Lewis gun again and shot down a Rumpler over Bailleul. During the Battle of Ypres we did quite a bit of ground strafing, and one day with Lt. Penn-Gaskell, who was a Lewis gun expert, we caused a lot of trouble to German convoys at Pezarches. We did a great deal of bombing of any suitable targets from quite low heights, using French 75 H.E. shells, carrying three in a tray under the wings on each side. We also dropped petrol bombs, hand grenades, and fléchettes (a kind of steel dart, 1,000 in a box). We used to count up the bullet holes and the top scorer had, I remember, sixty to his credit; but one day I nearly doubled the number by getting sixty-four in one flight. This seems to show that No. 5 Sqn., when it could, joined in the battle on the ground quite a bit in those anxious days when the cooks and batmen had to turn to and fight in the defence of Ypres. My longest day's flying—consisting of four sorties—was five hours 15 minutes, and I dropped a total of 36 bombs.

The late Air Chief Marshal Sir Trafford Leigh-Mallory, who was a flight commander in No. 5 Sqn. in 1917.

The winter on Bailleul aerodrome was not very comfortable. The ground got very wet and ended up almost a complete area of ashes. One day I could not get the Avro off the ground in the early morning, in spite of full revs and with the engine O.K. After the third attempt we found that as it had snowed and then frozen in the night I had about an inch of solid ice on the top plane. We flew quite a lot on both Christmas Eve and Christmas Day, and throughout the early part of January 1915 I was doing photography work with Lt. Gladstone as observer. This nearly led to my last flight in the R.F.C., for my Avro got what must have been a big piece of shell up through the fuselage—taking off the sole of one of my boots, the back of Gladstone's seat and part of his flying coat and leaving a gaping hole in the top centre section. We got home otherwise unscathed, but the machine was a write-off, all four longerons being damaged beyond repair—so why it did not break up is a mystery. This was, however, my last flight in No. 5 Sqn, for next day I was posted to No. 6 as a flight commander.

No. 5 was a very happy squadron indeed, and we were fortunate in having a crowd of officers and airmen who could get a lot of fun out of the worst possible conditions. Maj. Higgins was a strict disciplinarian but much loved, and so were the flight commanders. I have been unconscious in the air (for a short while) and on the ground, have been put to bed and once buried by No. 5 Squadron. I profitably learnt more about flying and life with No. 5 than in all my time since. They were happy days.

Our three contributors take the history to the opening of the second Battle of Ypres, ever remembered for the use for the first time of poison gas by the Germans. The green clouds were first seen by Strange, who was by then a pilot with No. 6 Squadron.

During the battle the squadron was re-organized, two flights having Avros and one Vickers Fighting Biplanes. "A" Flight (Avros) specialized in wireless, and the other two in reconnaissance, photography, bombing, etc. The unit did the work for III Corps until, with the other squadrons forming the 2nd Wing (Nos. 6 and 8), it came under the direction of Plumer's Force.

After the second Battle of Ypres had fought itself to a standstill at the end of May (1915) No. 5 had a comparatively quiet time until July, when the Germans attacked Hooge, using liquid fire for the first time.

On September 25, 1915, the Battle of Loos opened and two days previously eight aircraft from No. 2 Wing (including two from No. 5) attacked the locomotive sheds at Valenciennes. The two 5 Sqn. pilots on B.E.2c's carried no observers, so that a single 112-lb bomb could be carried with the minimum loss of performance. Smart, one of No. 5's pilots, was attacked over the target by a Fokker "firing a machine gun through the propeller"—a very early reference to intercepter gear. Smart is reported to have repelled the Fokker with his automatic pistol. For the remainder of the battle No. 5 Sqn. continued its work against railways, doing its best to hamper enemy troop movements.

During 1915 the unit had been more or less completely equipped with B.E.2c aircraft, plus a scout type which varied through the year from a Martinsyde to a Bristol, an F.E.8 and a D.H.2. On December 21, 1915, Maj. Board returned to England and was succeeded by Maj. J. G. Hearson, R.E.

(to be continued)

CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns; the names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

Vital Statistics of a Twin

LAST week *Flight*, outlining developments in business flying, was of great interest to me, and I thought your readers might like to know something about the economics of the Miles Gemini 3A that has done such sterling work for Lec Refrigeration, Ltd., including a sales tour earlier this year of 21 countries in Europe and North Africa.

The Gemini was the fourth in a line of progressively bigger executive aircraft operated by the firm, and has recently been replaced by an Avro 19, to be fitted as a flying showroom [picture, page 492, *Flight*, September 20].

During the last 12 months, the Gemini flew some 200 hr and the cost to the firm was surprisingly low, just over £11 2s an hr, or 1/6 an air mile. The fact that Lec have their own airstrip adjoining the factory, so avoiding hangarage and transport costs, doubtless helped to achieve this result. In addition, the Lec pilot is actually a refrigeration technician and undertakes flying duties as an offshoot of his main work. His cost to the firm as a pilot is therefore only £1 a flying hour. Other expenses for the year were insurance, £365; fuel, £525; maintenance, landings, etc., £1,140, giving a total of £2,230.

With only 200 hr flown there was little depreciation to take into account. Had Lec flown their normal 500 hr, however, depreciation would probably have been in the region of £1,000. But offset against this would naturally be a greater spread-over of fixed costs such as insurance, in effect reducing the cost of flying the Gemini to about £9 6s an hr.

In any event, the directors do not weigh the cost where their aircraft is concerned—prestige value and convenience are far more important. As Mr. Frank Purley, our export director, says (he will shortly be going on the first sales tour with the Avro 19): "Were the cost twice as much, it would still be worth it."

Bognor Regis, Sussex. R. E. STEVENS,
Public Relations Officer, Lec Refrigeration, Ltd.

The Technician and his Status

I CAN only quote, in reply to the anonymous "Twelve Aircraft Technicians" and the thirteenth "Another Aircraft Technician" some lines written by the first Marquis of Montrose. They are:—

"He either fears his fate too much
Or his deserts are small,
That dare not put it to the touch
To gain or lose it all."

Brighton, Sussex. J. LAURENCE PRITCHARD.

A.O.P.A. on the Big Fix

AN excellent summary, your leading article "Navigation's Big Fix" in the September 6 *Flight*. First, though, one quick correction. In your fourth paragraph you say: ". . . but in the military/civil partnership the armed forces remained dominant and V.O.R., as a point-source aid, was their favourite. . . ." Not so; the V.O.R. has always been the civil favourite primarily. In the interest of attempting to establish a so-called Common System, the military also concurred. But the original V.O.R./D.M.E. was essentially a civil concept, and was carried forward and installed by our civil authorities.

Once we prised the much-abused military-security lid off the history of what transpired within the military after the V.O.R./D.M.E. system has been agreed to, we found our Navy had been working on a highly specialized device for the sole purpose of doing a better job of getting carrier-based aircraft back to the carriers. This was to be the successor to YE or YG or whatever it was called [YG—Ed.]. But when the military engineers got to studying this Navy system, they saw other possibilities they could design into it. This was Tacan, essentially as we know it today. After that, the U.S. Air Force decided it liked the Navy device, and from that point on the V.O.R./D.M.E. system, which the American taxpayers had already bought and paid for, was doomed.

As you've no doubt noted, A.O.P.A. is especially concerned over the point you yourself have made: that the system in the U.S. now must accommodate both non-tactical and tactical military aviation. Personally, I regard this change in the original ground rules (a change forced through by our military during the Tacan controversy) as perhaps the most damaging single blow to civil aviation in this decade, more damaging than the Tacan fiasco itself. Civil aviation here—and throughout the world, if the U.S. has any strong voice in I.C.A.O.—now is irrevocably tied to the merest whim of the military. And our military are already talking glowingly of Doppler and inertial-guidance systems, the latest developments in the state of the air navigation art.

Our Common System concept in the U.S. has been a fallacy almost from the day the term was invented. The original idea, of course, was to invest public funds in just one basic system to serve all users of the airspace. The best we can say for the term is that it was invented for reasons of political expediency. That was back in the 1940s, and look what we have in the U.S. at this very moment: low-frequency four-course ranges, non-directional beacons, V.O.R.s, civil D.M.E.s (the doomed version), Tacans, Vortacs (one Tacan plus a V.O.R.) and radars. Then, of course, the Common System also is supposed to include landing aids. So we have an ever-increasing number of G.C.A.s, right along with a large number of I.L.S.s (which do the same job as G.C.A., but not so well). And so on and on.

In reality, the Common System is more like the Great Electronic Stew, with the military forever throwing some new ingredient into the pot. To say that this is giving the American taxpayer indigestion is putting it mildly.

The only practical solution—and undoubtedly the most economical in the long run—is clearly and positively to separate the military from the civil. Then the military should be told that, whatever system they think they can get the money for, must be a system that enables them to fly prescribed airways accurately, and make position reports when and where they're told to make them. Thus the basically civil air traffic control system can control the flow of both civil and military traffic together, while the military use whatever new-fangled system happens to serve their purpose at the moment.

Washington D.C. MAX KARANT,
Vice-president, Aircraft Owners and Pilots Association.

Map Riddle from World War I

FOR some time past I have been collecting material for the history of No. 112 (Shark) Squadron, and amongst the interesting things that have been located is a patrol map used by a squadron pilot in the First World War.

There are some puzzling features about it and I would be very interested to hear from anyone who can explain the following additions to the map (the map itself is an Ordnance Survey ½in/mile, 1912 edition of London and S.E. England).

There is a black line drawn from the centre of the Thames estuary (Shingles Bank) to Thames Haven, thence to a point between Croydon and Coulsdon, then to Cranbrook in Kent, and finally finishing up bisecting Hastings. I assume that this may be the "patrol area."

Within this area (which is roughly the county of Kent) the following airfields are marked in differing colours: Lympne (two concentric circles, red outer, blue inner); Lydd (two concentric circles, red outer, yellow inner); Detling, Throwley and Bekesbourne (red); South Ash, Kingshill, Marden, Frinstead, Pluckley, Swingfield and Broad Salts (yellow); Pett, Rye, Leigh Green, All Hallows and Broomfield (blue); and Biggin Hill, Wye and Dover (uncoloured). There is one odd one, Sole Street, marked as a pecked circle and uncoloured. At Hunton there is an uncoloured circle drawn in blue ink, which is the same way that the airfields *outside* the "patrol area" are marked—Barnham, Rochford, Stow Maries, Brentwood, Joyce Green, Sutton's Farm, Plumstead, Hainault Farm, Chingford, Croydon, Debden, Northolt, Twickenham, Coulsdon, Chiddingstone and Newhaven.

The following places have been underlined in red ink with numerals added alongside: Dover (6), Lympne (7), Rye (8), Calais (9), Maidstone (10), Chiddingstone (11), Hounslow (12), Joyce Green (13), Debden (14), Brentwood (15), Maldon (16), The Naze (17) and the Girdler Lightship (18).

Finally, two "Ground Signal Stations" are marked, one at Pett and the other just outside Margate, and at Harrietsham there is a small rectangle with HQ5 (or HQS) and a triangle.

R.A.F. Little Rissington, Glos. R. A. BROWN,
Flight Lieutenant.

IN BRIEF

Mr. Dennis Rush (96 Russell Street, Middlesbrough, Yorks) is hon. secretary of The Tees-side U.F.O. Research Group, a body of interested persons formed to study the phenomena of Unidentified Flying Objects. Regretting the fact that no official information on the subject has so far been released in this country, he appeals to aircrews (in particular) for evidence.

ever since the industry gained its wings...

DUNLOP

HAS SERVED AVIATION WITH AN EVER-INCREASING RANGE OF EQUIPMENT

TYRES, WHEELS AND BRAKES

MAXARET ANTI-SKID UNITS

PNEUMATIC ACTUATING SYSTEMS

WINDSCREEN WIPER SYSTEMS

GUIDED MISSILE EQUIPMENT

BRAKE CONTROL SYSTEMS

FLEXIBLE PIPES

DE-ICING SYSTEMS

RUBBER ACCESSORIES, etc., etc.

ANTI-G SUITS AND VALVES

● DUNLOP RUBBER CO. LTD. (AVIATION DIVISION) FOLESHILL, COVENTRY 7H/618

PHOTOGRAPH BY COURTESY OF "FLIGHT"

DAGENITE AIRCRAFT BATTERIES
chosen for the
VICKERS
VISCOUNT
800
G-AOJA
Dagenite 24-volt 25 Ah. aircraft batteries
ventilated type 12ECM13-VA are initial equipment
on the Vickers Viscount 800 airliner.
Dagenite aircraft batteries are in world-wide
service on many types of aircraft.
Dagenite AIRCRAFT BATTERIES
MADE LIGHT FOR FLIGHT!
PETO & RADFORD, 197 VICTORIA STREET, LONDON SW1 · Tel: TATe Gallery 9212
PR 27

THE AERONAUTICAL BOOKSHELF

"The Millionth Chance," by James Leasor. Hamish Hamilton, Ltd., 90 Great Russell Street, London, W.C.1. Illustrated. Price 18s.

NO other tragedy in British aviation has ever aroused quite the same widespread poignance as the loss of the R.101. Like the *Titanic* disaster, the event was of epic proportions; and on both occasions there was national grief. It seems surprising that only now—nearly 27 years after the event—has a book appeared which gives a complete account of the great airship from her conception in 1924 to her demise, six years later, on a French hillside with the loss of all but six of the 54 persons on board. Since those days a generation has grown up which has never seen a British airship, for work on them was stopped abruptly following the R.101 tragedy. Her successful rival the R.100—which, built by private enterprise, had flown safely to Canada and back—was broken up.

The R.101 story is now, therefore, matter for history; and Mr. Leasor has told it with a nice blend of detachment and vividness. His method is admirable: a description of the airship's departure on that stormy Saturday night in October, 1930; an account of her design and building; then a recounting—based on survivors' and witnesses' stories and contemporary reports—of her end and the melancholy obsequies. Only in one respect does his judgment seem at fault, when he dismisses in three paragraphs the Court of Inquiry report, which is surely of more interest to posterity than a description of the mass funeral that occupies three pages.

What reasons were given by the Court for the disaster? It concluded that the immediate cause was a sudden loss of gas in a forward gas-bag at a time when the nose of the airship was being depressed by a downward current of air. Another possible contributory factor was considered to be the changing of the watch at 2 a.m.—five minutes before the crash occurred—so that the new men had not had time to get the "feel" of the ship. Further, R.101 had started for India "before she could be regarded as having emerged successfully from all the exhaustive tests proper to an experimental stage."

Mr. Leasor also mentions a letter written by an A.I.D. inspector, warning of gas-bag chafing. This warning went officially unheeded because of further delays which would have been involved by modifications. He notes, too, that a C. of A. was issued before a report being prepared by two independent experts had been received. He further records in an appendix two extremely interesting séances at which the voices of Irwin, Sir Sefton Brancker and others were apparently heard describing what occurred.

Who was to blame for the disaster? Lord Thomson, the Air Minister, who wanted to make the trip for prestige purposes and was determined to be back in London for the Imperial Conference on October 20? F/L. Irwin, the captain, who started the flight in highly adverse weather conditions? No blame was ever apportioned for the accident, and quite rightly so; for those responsible for designing, building and flying the great airship all perished in her. Their story has the awful inevitability of a Greek tragedy. Conscientious, dedicated and skilful, they nevertheless seem to have been pursued by some Nemesis which dogged their endeavours and finally marked them for destruction.

H. W.

"Air Dates," by A. Cdre. L. G. S. Payne, C.B.E., M.C., A.F.C. William Heinemann, Ltd., 99 Great Russell Street, London, W.C.1. Price 42s.

THERE has long been room on the aviation bookshelf for a reference work listing concisely and accurately all the important "air dates" since Pilatre de Rozier left the ground in a Montgolfier hot-air balloon on October 15, 1783. Sadly, this painstaking work by the respected air correspondent of the *Daily Telegraph* does not altogether fill the gap.

A note on the cover states that *Air Dates* is "A chronological survey of the principal events in the fields of military and civil aviation in Great Britain and abroad, beginning in 1783 . . . and ending on 31 December 1956." Yet the enquiring reader would search in vain for any reference to the work of Ader, Maxim, Pénaud or Curtiss, for Santos-Dumont's officially-recognized first flight in Europe on October 23, 1906, for the first helicopter flights by Bréguet and Cornu in 1907, the first flying meeting at Rheims in 1909, the first seaplane flight in 1910, the first official air mail service in 1911, or the first take-off and landing on a ship, by Eugene Ely.

There is a reference to the first German air raid on this country on December 21, 1914, but no mention of the first British raid on Germany three months earlier. Even more strange, a glance at the index reveals not a single reference to the work of Sir Alliott Verdon Roe, whereas the enemy *army* commander Rommel gets 22 entries, which seems incongruous in a book of "air" dates.

In this lies the clue to the entire worth of A. Cdre. Payne's book: in fact, as is stated *inside* the dust jacket, the major part concerns itself with the years 1939 to 1956. As a result, on pages 262-3, for example, we can read that R.A.F. Mosquitoes bombed unspecified targets in the Ruhr on July 12-13 and 13-14, 1944, attacked Hanover on July 14-15, Berlin on July 15-16, a synthetic oil plant at Hamburg on July 16-17, and so on. Sixty pages later, there are dates for the entry of the Soviet Army into Bratislava, Konigsberg and Vienna.

In short, the author covers the first 155 years of flight (up to 1938) in 81 pages and devotes 267 pages to the next seven years, so that one questions whether his book can really claim to live up to its stated contents. Nevertheless, the information he provides, usually difficult to track down, is of a kind which can be useful, especially to journalists. They may even have to confirm the dreary fact that Adolf Hitler was born on April 19, 1889.

J. T.

"Flynn's Flying Doctors" by Harry Hudson. William Heinemann, 99 Gt. Russell Street, London, W.C.1. Illustrated. Price 25s.

MOST of us know of the Royal Australian Flying Doctor Service. We know that it is one of the amenities which make life in the Outback more tolerable—and give the inhabitants a better chance of survival—than before it was started in 1928. The subject is an obvious one for a book, and Mr. Hudson has written it as an entertaining diary of a 20,000-mile journey which he made "discovering" his own country for himself. The trek brought him into close contact with the flying doctors, and his story relates the details of their life. It shows, too, how their aeroplanes have done more than act as ambulances—how they have really helped in opening up the hinterland. It is a comprehensive story and introduces two of the Service's pioneers—the late Very Rev. John Flynn, who had as his parish the whole of the Australian Inland and who founded the Flying Doctors, and Dr. Allan Vickers, the best known of the doctors, who has been in the service for more than 20 years.

A. C. B.

"Aircraft Annual 1958," edited by John W. R. Taylor. Ian Allan, Ltd., Craven House, Hampton Court, Surrey. Illustrated. Price 10s 6d.

ANOTHER edifying and entertaining half-guinea's-worth of miscellaneous aeronautical literature and pictures is here assembled under Mr. Taylor's editorship. Contributors include Air Marshal Sir Robert Saundby, Kenneth W. Gatland, Maurice F. Allward, Patricia and John Stroud, "Apex," Cyril Peckham and James Hay Stevens; and topics range from "Flying Without a Motor," to "Atlas and Titan." For oneself, "Collectors' Corner" is always a big attraction, and this time we have a gallery of twelve rarities, including a Snipe of 17 Squadron in one of the earliest known photographs showing the current series of fighter markings; a Virginia with gunners' nacelles outrigged from the upper wing; the crimson D.H.9A used by Sir Robert Brooke-Popham when A.O.C. Iraq; and the first photograph ever published of the "one-off" Typhoon night fighter with A.I. radar installation. (The receiver, modulator and transmitter were housed in the port-wing fuel-tank bay.)

H. F. K.

"I'll Climb Mount Everest Alone," by Dennis Roberts. Robert Hale, Ltd., 63 Old Brompton Road, London, S.W.7. Illustrated. Price 15s.

IN this book Dennis Roberts has written-up the diary of Maurice Wilson which was found on the mountaineer's body at 21,000ft on the icy slopes of Everest in 1935. This is not essentially an aviation story. Wilson embarked on an adventure: flying to India in a D.H. Moth and then planning to land the aircraft as close as possible to the summit of Everest, preparatory to continuing the ascent on foot. A refusal to allow him to fly over Nepal to the mountain ended the flying side of the story—except that the indomitable spirit which was his in the cockpit stayed with him during his three attempts to conquer Everest on foot.

A. C. B.

"Sell's British Aviation 1957." Business Dictionaries, Ltd., St. Dunstan's House, 133-137 Fetter Lane, London, E.C.4. Price 15s.

NOW in its tenth year, this useful directory provides a comprehensive guide to the British aircraft and associated industries and organizations. Features include a section on current British civil aircraft specifications, and this year a brief international aviation list has been added. The main body of the directory is divided into classified products and names-and-addresses sections. It should be emphasized that the price is as quoted above, and not as given in our "other books received" column a fortnight ago.

THE INDUSTRY

Dowty Group Progress

FIGURES presented at the annual general meeting of the Dowty Group, Ltd. (held at Arle Court, Cheltenham, on October 28), show a net profit after taxation of £792,322, compared with £777,171 for the previous year. In his statement the chairman, Sir George Dowty, said that for the first time in the group's history undercarriages were being supplied to the U.S.A., for the Fokker Friendship being built by Fairchild; and he added that the Lockheed Starfighter uses Dowty Liquid Spring shock absorbers manufactured under licence by the Cleveland Pneumatic Tool Co.

Dunlop Changes

AS briefly noted in a news-item on October 11, Sir George Beharrell has resigned from the presidency of the Dunlop Rubber Co., Ltd., and therefore from the Board (which has placed on record its appreciation of "his distinguished part in the history and development of the Dunlop group"), but has consented to act as an honorary consultant. Lord Baillieu, who at his own request has been relieved from his duties as chairman, succeeds Sir George as president. Mr. G. E. Beharrell has been elected chairman of the Board in succession to Lord Baillieu and will continue to act as the company's chief executive.

At the directors' meeting which received Sir George's resignation, Mr. John H. Lord and Mr. R. M. Geddes were appointed managing directors and Mr. T. E. Peppercorn an executive member of the Board.

Miles Electronics

IT was recently announced that expansion of the electronics division of F. G. Miles, Ltd., has led to their associating with the Lombard Development Corporation, Ltd., in the formation of a new company, Miles Electronics, Ltd. Its directors are F. G. Miles, G. H. Miles, Mrs. O. M. Wadlow, J. W. P. Angell, Paul H. A. Bowman and Leslie H. Davies (the two last-named representing Lombard Development Corporation, a subsidiary of Lombard Banking). Chief engineer and manager of the new company is Mr. C. H. Bickerdyke.

A statement accompanying the announcement says that participation with Miles Electronics, Ltd., is "a natural outcome of the policy of Lombard Development Corporation, Ltd., to invest in the expanding world of electronics and automation. Miles Electronics, Ltd., is at present mainly concerned with the design and construction of flight simulators." This enterprise will be associated with present work on analogue computers.

Transistors in the Making

AS recorded on this page last week, the new factory of Texas Instruments, Ltd., at Bedford, formally opened on October 1, is in production with a range of silicon transistors and related devices. The company is a subsidiary of Texas Instruments, Inc., of Dallas, U.S.A.

Although first developed less than ten years ago, the transistor has made swift progress in its rôle of substitute for the electronic valve, principally by virtue of the facts that it is very much smaller, is less fragile, requires only a nominal operating current, and theoretically has an almost infinite working life.

Until a little over three years ago the crystalline material from which transistors were manufactured was germanium; then silicon transistors began to be produced on a commercial scale (it is the claim of Texas Instruments, Inc., that they were the first company to do so). The principal advantage claimed for silicon in comparison with germanium is that it will operate efficiently at much higher temperatures, and this attribute is a critical one in many applications, of which missile equipment is an example.

As we were able to see during a short tour of the Bedford plant, the process of "growing" silicon crystals for transistors is a highly specialized one. An extremely pure silicon is initially employed (impurities, it is stated, amount to less than one part in a million), and is melted by induction heating in a quartz crucible. This process is conducted in an ingenious apparatus whereby, under electronic control, a revolving rod is dipped into the melt and slowly withdrawn so that it pulls up what might be described as an inverted mushroom of cooling and solidifying crystal. At certain predetermined moments in the process minute quantities of impurities are metered into the melt, with the result that the head of the mushroom, by the time it is fully withdrawn and solidified, consists of three sharply defined layers of differing purities, which will ultimately constitute the collector, base and emitter regions of the transistor. The base region—which, in spite of its name, is sandwiched between the other two—is only about 0.0001in thick. The "sandwich"—about half-an-inch thick—is then divided vertically by means of an ultrasonic cutter to yield some scores of square bars, each of about the size of one-third of a matchstick, and each containing the three regions in succession along its length.

Subsequent processes include the soldering of three connector-wires to each bar. Attachment of the wire to the thin base-region is a particularly delicate operation that has to be performed under a microscope. After hermatic sealing into a case, the finished transistor is subjected to a series of temperature-cycle, shock and vibration tests.

The interior appearance of the Texas Instruments works is that of a laboratory. Crystal ingredients are weighed in a dust-excluding room; and some of the processes are performed by girls with their hands inside inert-atmosphere cabinets.

Although, for security reasons, the more significant applications could not be shown, a demonstration at Bedford illustrated how, though operating at 100 deg C, resistors could be used to provide a 15W output from an electronic amplifier of the kind that might be used to power aircraft instrumentation or a missile servomotor. In another they were shown amplifying the signal from a photocell in order to vary the iris-aperture of a camera-gun.

British Aluminium Appointments

CHANGES in the Board of the British Aluminium Co., Ltd., have been announced. Mr. W. H. Harrison and Mr. E. Holland-Martin recently relinquished their directorships and the vacancies thus created, together with one already existing, have been filled by Mr. G. A. Anderson (as director and general sales manager); and Mr. W. B. C. Perrycoste and Mr. J. Salter (each as director and general production manager). Mr. G. W. Lacey, formerly director in charge of sales, has assumed the title of commercial director.

Expanded-plastic Applications

AT a recent meeting in London, Expanded Plastics, Ltd., of 675 Mitcham Road, Croydon (a subsidiary of the Expanded Rubber Co., Ltd.), showed applications of their material Polyzote. This is expanded polystyrene, formed by the expanding in steam of granules which are constrained in a mould, and cooling the tool in water. Various adhesives are suitable for bonding the resultant very light blocks to sheets of plywood, plastic or aluminium.

The material has obvious uses, the manufacturers say, in such applications as removable bulkheads or partitions in aircraft. It can also be usefully employed as a low-temperature insulator for aircraft or missile electric, electronic and radio equipment, or for the packaging of a wide variety of fragile articles.

IN BRIEF

Mr. W. E. Ogden and Mr. W. W. Dolton, chairman and managing director respectively of the Delta Metal Co., Ltd., have been appointed directors of James Booth and Co., Ltd., and of its subsidiary, John Wilkes, Sons and Mapplebeck, Ltd.

* * *

Mr. Arthur Elliott, commercial director of Precision Rubbers, Ltd., was presented with the Swinbank gold medal at this year's annual conference of the Purchasing Officers' Association, for his "outstanding services to purchasing."

* * *

Mr. R. G. Wilkinson has relinquished his appointment as development manager of Magnesium Elektron, Ltd., and is succeeded by Mr. K. G. D. Bailey.

* * *

The Plessey Co., Ltd., has announced the appointment of Mr. Eric E. Pratt—formerly sales manager with Airtech, Ltd., and before that with the Mullard, Ltd., equipment division—as commercial manager in the electronics and equipment group.

* * *

Aero Research, Ltd., Duxford, Cambridge, have produced a 16 mm sound and colour film describing the "Redux" bonding process for aircraft structures. Running for 17 minutes, the film is available in French, German, Italian and Japanese (with soundtrack for magnetic reproduction) as well as in English (optical reproduction).

Mr. C. W. Sharp, managing director of Electro-Hydraulics, Ltd., and Conveyancer Fork Trucks, Ltd. (two of the Owen Organization companies), who leaves England on October 22 for a three-months' world tour. This will include visits to the companies' subsidiary plants in Sydney and Toronto and to the parent company's factories in Melbourne and Toronto.

GLOSTER AIRCRAFT CO. LTD., GLOUCESTER, ENGLAND. *Member of the Hawker Siddeley Group / Pioneer . . . and World Leader in Aviation*

PERFORMANCE. VOLTAGE: 28*v. regulated*. SPEED RANGE: 2,860 *to* 10,000 *r.p.m.* (3·5 *to* 1). OUTPUT: 6,000 *watts*. TEMPERATURE RANGE: —40°C *to* +50°C. WEIGHT: 61·25 lbs.

Improved Wide Speed Generator

DESIGN FEATURES. Brazed conductors; high temperature insulation materials; shrunk steel banding rings; commutators shrunk onto shaft; shunt, interpole and compensating windings; blast cooled at 15 lbs. of air per minute at 70°F.; quick release manacle mounting; electrical connections and suppressor in one box. These features permit high armature speeds, and high current densities with a resultant power-to-weight ratio of 100 : 1 in watts per lb. Internal suppression reduces cable screening and resultant weight of system.

Complete Electrical and Starting Systems for Aircraft

ROTAX

ROTAX LIMITED, WILLESDEN JUNCTION, LONDON, N.W.10. Tel. Elgar 7777.
LUCAS-ROTAX (AUSTRALIA) PTY., LTD., MELBOURNE & SYDNEY, AUSTRALIA.
LUCAS-ROTAX LTD., TORONTO, MONTREAL & VANCOUVER, CANADA.

During official visits abroad the Secretary of State for Air, Mr. George Ward, is seen (above, left) at the F.E.A.F. headquarters officers' mess and the C.A.S., Sir Dermot Boyle (above, right), at Bolling A.F.B., Washington. With Mr. Ward are (left to right) A. Cdre. G. W. McAleer, P.M.O.; Air Marshal the Earl of Bandon, C-in-C.; Wg/O. C. E. Warren, Command W.R.A.F. Admin. Officer; and A.V-M. A. A. Adams, Chief of Staff. Behind Air Chief Marshal Sir Dermot Boyle as he inspects a guard of honour can just be seen his U.S.A.F. host, Gen. Thomas D. White.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

Senior F.A.A. Appointments

FOLLOWING Vice-Admiral M. L. Power's appointment—announced in July and taking effect this month—as Deputy Chief of Naval Staff and Fifth Sea Lord, Acting Rear Admiral H. C. D. MacLean has succeeded him as Flag Officer Aircraft Carriers. Prior to his new appointment, Admiral MacLean was Director of Plans. A navigation specialist, he was in H.M.S. *Cossack* at the time of the *Altmark* incident, being mentioned in despatches for his part in this action; from 1940 until her sinking in 1941 he was navigator of H.M.S. *Ark Royal* and subsequently (until 1944) of H.M.S. *Anson*. He holds the D.S.C.

Also announced by the Admiralty is the appointment of Acting Rear Admiral D. R. F. Cambell as Flag Officer Flying Training in succession to Rear Admiral C. L. G. Evans. Admiral Cambell—who is succeeded as Director of Naval Air Warfare by Capt. R. E. N. Kearney—commanded No. 803 Sqn. in H.M.S. *Ark Royal* in 1939, being awarded the D.S.C. the following year for his general good services with the Fleet Air Arm. During 1940 and 1941 he was a test pilot at Boscombe Down, and one of his later wartime appointments was as Commander (Flying) in H.M.S. *Argus*. Between 1950 and 1953, when Director of Naval Aircraft Development and Production (Admiralty), he was responsible—in conjunction with Mr. L. Boddington—for the conception of the angled deck.

Capt. Kearney, the new D.N.A.W., was formerly deputy director and prior to taking up that appointment in December 1956 was Commander (Air) in H.M.S. *Illustrious*.

G/C. J. Woodroffe

WE regret to record that G/C. John Woodroffe, D.S.O., D.F.C. and Bar, commander of the R.A.F. detachment at Pinecastle A.F.B. for the S.A.C. bombing competition, was killed in an accident to a B-47 on October 9. He was on a familiarization flight with Col. M. McCoy, who commanded the 321st Bombardment Wing at Pinecastle and whose 52nd birthday it was. All four occupants of the aircraft were killed.

G/C. Woodroffe, station commander at Wittering, joined the R.A.F. in 1938 and during the war became a Master Bomber in No. 5 Group on Mosquitoes and Lancasters. One of his finest achievements was in controlling the attack which breached the Dortmund-Ems Canal.

The Editor has contributed the following personal appreciation:—

G/C. John Woodroffe was unlike any other Air Force officer I have known. There was an engaging boyishness about his way of tackling a man's job and he was as likely to laugh on being confronted with a tough problem as when told an amusing story.

During the war nights there were those who allowed their depression to overflow on to others; not so with Johnny Woodroffe. He worried more than most about his operational flights with Bomber Command—and about his wife at home, too; but one needed to be very close to him to know it. He was usually the man who helped to keep up everyone else's spirits.

As a Pathfinder and Master Bomber he was determined to make the raids he controlled successful; and after very few sorties, a mention of his name at briefing never failed to bring a word of approval from the crews. His decorations were well earned. In particular a night raid on July 26, 1944, in appalling weather conditions must have been abortive but for Woodroffe. This brought him an immediate D.F.C.

After the war he continued to be full of drive and a great man for getting things done. He had no time for the pompous or for bull and he was ready to avoid the "proper channels" if less conventional action seemed likely to produce quicker or better results. On the other hand he was exceptionally conscientious and very loyal to the R.A.F. and to the men who worked with him.

The confidence that his senior officers had in his ability is evident from his appointments to commands of special importance during and after the war. He was one of the first officers to be selected for the Canberra force when the R.A.F. was making its important, if tardy, change-over to jet bombers; and more recently he was given command of the station at which the first Valiant squadrons were based.

Johnny Woodroffe's passing will be a very great loss to the R.A.F. and also to his fellow officers and his friends outside the Service.

G/C. Woodroffe is succeeded as commander of the R.A.F. detachment at Pinecastle by G/C. W. J. Burnett. The competition is discussed in an article on p. 615.

R.A.F. Appointments

BELOW is continued a list of R.A.F. appointments recently announced by the Air Ministry:—

W/C. J. J. da C. Andrade to A.H.Q., Levant, for equipment staff duties; W/C. E. C. Ashley to Air Ministry, for duty in the Department of the Air Member for Supply and Organization; W/C. K. H. Burns to No. 3 M.U., for administrative duties; W/C. H. G. Cadwallader to H.Q., No. 41 Group, for air staff duties; W/C. S. F. Kettell to SHAPE, for staff duties; W/C. B. R. Siminson to H.Q., 2nd T.A.F., for administrative staff duties; W/C. W. E. G. Vaughan to H.Q., Home Command, for administrative staff duties; W/C. E. B. O'H. Bennett to H.Q., No. 83 Group, for technical staff duties; W/C. F. J. Fenner to R.A.F. Yatesbury, for technical duties; W/C. E. Holden to H.Q., Fighter Command, for air

Captain and first officer of the R.C.A.F. C-5 in which the Queen and Prince Philip were due to fly from Uplands Airport, Ottawa, to Patrick Henry Airport, Washington, last Wednesday. At left, W/C. W. G. S. Miller, the captain; right, F/L. R. G. Husch, first officer.

A Canberra B.2 of No. 32 Squadron (above, left), based at Akrotiri, Cyprus, bearing squadron markings on its tip tanks. (Heraldic note for the squadron: Correctly the blue stripes should slope in the opposite sense and be separated by very narrow strips of silver, as witness the adjoining thirty-year-old close-up of a No. 32 Sqn. Gamecock.)

SERVICE AVIATION . . .

staff duties; W/C. E. F. Nind to R.A.F. Stanbridge, for administrative duties; Acting W/C. S. H. Latham to H.Q., Technical Training Command, for administrative staff duties (retaining acting rank of wing commander); Acting W/C. A. R. Boardman to R.A.F. Swinderby, for technical duties (retaining acting rank of wing commander).

S/L. S. M. Davidson to Air Ministry, for duty in the Department of the Chief of the Air Staff (with acting rank of wing commander); S/L. J. H. Spencer to H.Q., Fighter Command, for technical staff duties (with acting rank of wing commander).

G.M. Award

FOR displaying "courage and extreme devotion to duty" when leading fire-fighting operations on a Canberra in a servicing hangar at R.A.F. Coningsby, Acting Cpl. Brian Murphy has been awarded the George Medal. One of the aircraft's fuel tanks was alight, but Cpl. Murphy unhesitatingly led his duty crew into the confined space of its bomb-bay, where—despite further hazard from the explosion of starter cartridges—they succeeded in localizing and controlling the fire.

Sharp Shooters

WINNERS of the R.A.F. Fighter Command air gunnery trophies for 1957 are No. 63 Sqn. (the Dacre Trophy for day fighter squadrons) and No. 264 (the Ingpen Trophy for all-weather fighter squadrons). No. 63 is commanded by S/L. S. Walker, equipped with Hunter F.6s and based at Waterbeach; and No. 264, flying Meteor N.F. 12s and 14s from Middleton St. George, is commanded by W/C. J. C. Forbes.

Runners-up were No. 19 Sqn. for the Dacre Trophy and No. 89 for the Ingpen Trophy.

Senior N.I. Post

ANNOUNCING that G/C. R. H. C. Burwell, officer commanding R.A.F. Aldergrove, has been appointed Senior Air Force Officer, Northern Ireland, with effect from October 16, Air Ministry says this change has been made "because of the closer proximity of Aldergrove to the seat of Government in Northern Ireland and so that R.A.F. advice and representation will be more readily available." The post was formerly held by G/C. P. A. Lombard, R.A.F. Director of the Joint Anti-Submarine School at Londonderry.

G/C. Burwell was commissioned in the R.A.F. in 1938. During the war he flew with Nos. 208, 162, 38 and 47 Squadrons in the Middle East and with No. 144 Sqn. —on which he was awarded the D.F.C.— in Coastal Command. He was appointed O.B.E. for his work as station commander at R.A.F. Hullavington in 1950.

Recently (as portrayed in the adjoining illustration) G/C. Burwell received on behalf of R.A.F. Aldergrove the Freedom of the city of Belfast.

IN BRIEF

A.Cdre. R. C. Mead, A.O.C. No. 81 Group, has invited 745 West of England members of the R.O.C. to visit R.A.F. Chivenor next Sunday, October 20.

* * * * *

A.V-M. J. R. Cassidy has been elected president of the first Australian branch of the R.A.F. Association. He was A.O.C. No. 27 Group, R.A.F., from 1941 to 1946 and retired from the Service in 1946.

* * * * *

Sabres and CF-100s of the R.C.A.F.'s No. 3 Fighter Wing, based at Zweibrucken in Germany, flew past when "Canada Day" was officially opened at the Metz international fair on October 1.

* * * * *

The Winter, 1957/58 edition of the *R.A.F. Athletic and Games Handbook* has now been published and is available from the R.A.F. Sports Board, Air Ministry, London, W.C.1, price 4s.

* * * * *

R.N. air station Stretton, near Warrington, is to close down in April 1959. Its 800 officers and ratings will be transferred to other stations and 250 civilian employees (mostly clerks and drivers) will be declared redundant.

* * * * *

During the first six months of this year the R.A.F. Benevolent Fund spent £301,833 on relieving distress among past and present members of the R.A.F. and W.R.A.F. and their families and dependants, assisting in 8,429 cases.

* * * * *

A Canberra of No. 76 Sqn, R.N.Z.A.F., recently completed the first of a series of survey flights over Fiordland, in the south-west corner of South Island. These are being undertaken for the N.Z. Lands and Survey Department and will cover 10,000 sq miles of the Southern Alps area.

* * * * *

The final round of the annual farms and gardens competition for R.A.F. units was won by Oakington, with St. Mawgan second and Stafford third.

* * * * *

A booklet describing the history and work of the R.A.F. Technical College—written by W/C. A. Beveridge, an education officer on its staff, and illustrated with both recent and pre-war photographs—has just been published by the Air Ministry.

* * * * *

The West German Government recently refused to renew a five-year agreement under which the R.A.F. has used the island of Knechtsand, near Cuxhaven, as a bombing range. Later it said that permission might be given if dummy bombs were used.

* * * * *

Figures published by the Ministry of Defence show that the three Services recruited only 2,794 men during August compared with 4,870 for the same month last year. The R.A.F. total was 752 as against 1,642 in 1956.

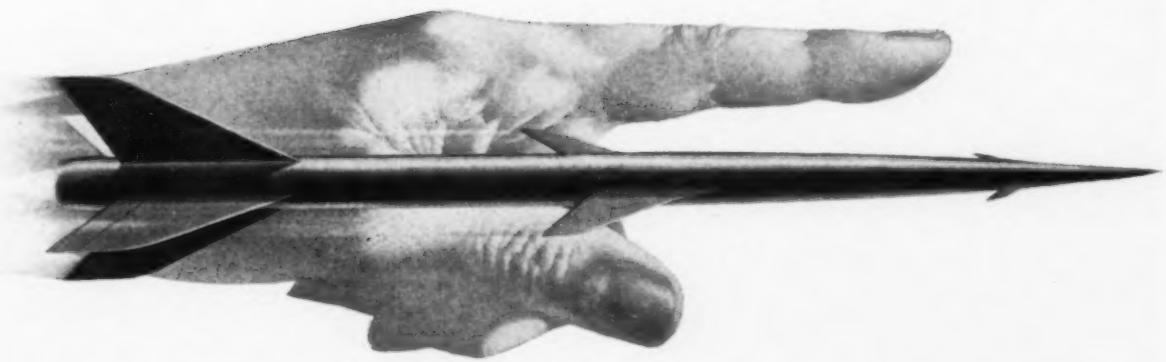
* * * * *

Following the disbandment of the R.N.V.R. air branch, No. 7 F.T.S.—which since 1954 has been the only advanced R.A.F. flying training school to train naval pilots on turbojet aircraft—will next year be merged with No. 1 F.T.S., Syerston, and both are to move to Lynton in Devon as No. 1 F.T.S.

G/C. R. H. C. Burwell, C.O. of R.A.F. Aldergrove, signing the roll of Freemen after the station had been elected an Honorary Burgess of the City of Belfast on October 5. To his left are the Lord Mayor (Ald. Cecil McKee) and the Town Clerk, and behind stand (from left to right) Air Marshal Sir Geoffrey Tuttle, the D.C.A.S.; Air Marshal Sir Bryan Reynolds, A.O.C.-in-C. Coastal Command; and A.V-M. P. D. Crocroft, who is A.O.C. No. 18 Group.

What next in the air? How high? How fast?

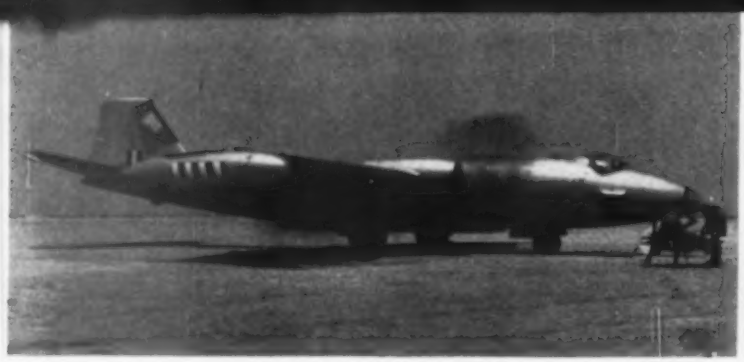
In meeting the demands for ever-increasing speed and altitude, the English Electric Aviation Group is tackling and progressively resolving the inherent problems of heating and cooling: for, apart from aerodynamic shape, future performance will be governed more and more by the ability of materials and components to endure a rapidly widening range of temperatures.
Whatever is to be the future of aviation, it is now being foreshadowed on the drawing-boards of English Electric, Marconi's and Napier—three famous firms sharing talents, experience and resources in the English Electric Aviation Group.



The projects on which we are now working are secret but our achievements speak for themselves—
English Electric produce the famous Canberra and supersonic P.1., and are now foremost in the development of Guided Weapons; Marconi's are pre-eminent in radar, radio and navigational aids; and Napier are renowned for experience in the design and production of gas turbines, ram jets and rocket motors.

English Electric • Marconi • Napier

THE BIG THREE WHO MAKE UP THE 'ENGLISH ELECTRIC' AVIATION GROUP



A Canberra B.2 of No. 32 Squadron (above, left), based at Akrotiri, Cyprus, bearing squadron markings on its tip tanks. (Heraldic note for the squadron: Correctly the blue stripes should slope in the opposite sense and be separated by very narrow strips of silver, as witness the adjoining thirty-year-old close-up of a No. 32 Sqn. Gamecock.)

SERVICE AVIATION . . .

staff duties; W/C. E. F. Nind to R.A.F. Stanbridge, for administrative duties; Acting W/C. S. H. Latham to H.Q., Technical Training Command, for administrative staff duties (retaining acting rank of wing commander); Acting W/C. A. R. Boardman to R.A.F. Swinderby, for technical duties (retaining acting rank of wing commander).

S/L. S. M. Davidson to Air Ministry, for duty in the Department of the Chief of the Air Staff (with acting rank of wing commander); S/L. J. H. Spencer to H.Q., Fighter Command, for technical staff duties (with acting rank of wing commander).

G.M. Award

FOR displaying "courage and extreme devotion to duty" when leading fire-fighting operations on a Canberra in a servicing hangar at R.A.F. Coningsby, Acting Cpl. Brian Murphy has been awarded the George Medal. One of the aircraft's fuel tanks was alight, but Cpl. Murphy unhesitatingly led his duty crew into the confined space of its bomb-bay, where—despite further hazard from the explosion of starter cartridges—they succeeded in localizing and controlling the fire.

Sharp Shooters

WINNERS of the R.A.F. Fighter Command air gunnery trophies for 1957 are No. 63 Sqn. (the Dacre Trophy for day fighter squadrons) and No. 264 (the Ingpen Trophy for all-weather fighter squadrons). No. 63 is commanded by S/L. S. Walker, equipped with Hunter F.6s and based at Waterbeach; and No. 264, flying Meteor N.F. 12s and 14s from Middleton St. George, is commanded by W/C. J. C. Forbes.

Runners-up were No. 19 Sqn. for the Dacre Trophy and No. 89 for the Ingpen Trophy.

Senior N.I. Post

ANNOUNCING that G/C. R. H. C. Burwell, officer commanding R.A.F. Aldergrove, has been appointed Senior Air Force Officer, Northern Ireland, with effect from October 16, Air Ministry says this change has been made "because of the closer proximity of Aldergrove to the seat of Government in Northern Ireland and so that R.A.F. advice and representation will be more readily available." The post was formerly held by G/C. P. A. Lombard, R.A.F. Director of the Joint Anti-Submarine School at Londonderry.

G/C. Burwell was commissioned in the R.A.F. in 1938. During the war he flew with Nos. 208, 162, 38 and 47 Squadrons in the Middle East and with No. 144 Sqn. —on which he was awarded the D.F.C.— in Coastal Command. He was appointed O.B.E. for his work as station commander at R.A.F. Hullavington in 1950.

Recently (as portrayed in the adjoining illustration) G/C. Burwell received on behalf of R.A.F. Aldergrove the Freedom of the city of Belfast.

IN BRIEF

A.Cdre. R. C. Mead, A.O.C. No. 81 Group, has invited 745 West of England members of the R.O.C. to visit R.A.F. Chivenor next Sunday, October 20.

* * * * *

A.V-M. J. R. Cassidy has been elected president of the first Australian branch of the R.A.F. Association. He was A.O.C. No. 27 Group, R.A.F., from 1941 to 1946 and retired from the Service in 1946.

* * * * *

Sabres and CF-100s of the R.C.A.F.'s No. 3 Fighter Wing, based at Zweibrucken in Germany, flew past when "Canada Day" was officially opened at the Metz international fair on October 1.

* * * * *

The Winter, 1957/58 edition of the *R.A.F. Athletic and Games Handbook* has now been published and is available from the R.A.F. Sports Board, Air Ministry, London, W.C.1, price 4s.

* * * * *

R.N. air station Stretton, near Warrington, is to close down in April 1959. Its 800 officers and ratings will be transferred to other stations and 250 civilian employees (mostly clerks and drivers) will be declared redundant.

* * * * *

During the first six months of this year the R.A.F. Benevolent Fund spent £301,833 on relieving distress among past and present members of the R.A.F. and W.R.A.F. and their families and dependants, assisting in 8,429 cases.

* * * * *

A Canberra of No. 76 Sqn, R.N.Z.A.F., recently completed the first of a series of survey flights over Fiordland, in the south-west corner of South Island. These are being undertaken for the N.Z. Lands and Survey Department and will cover 10,000 sq miles of the Southern Alps area.

* * * * *

The final round of the annual farms and gardens competition for R.A.F. units was won by Oakington, with St. Mawgan second and Stafford third.

* * * * *

A booklet describing the history and work of the R.A.F. Technical College—written by W/C. A. Beveridge, an education officer on its staff, and illustrated with both recent and pre-war photographs—has just been published by the Air Ministry.

* * * * *

The West German Government recently refused to renew a five-year agreement under which the R.A.F. has used the island of Knechtsand, near Cuxhaven, as a bombing range. Later it said that permission might be given if dummy bombs were used.

* * * * *

Figures published by the Ministry of Defence show that the three Services recruited only 2,794 men during August compared with 4,870 for the same month last year. The R.A.F. total was 752 as against 1,642 in 1957.

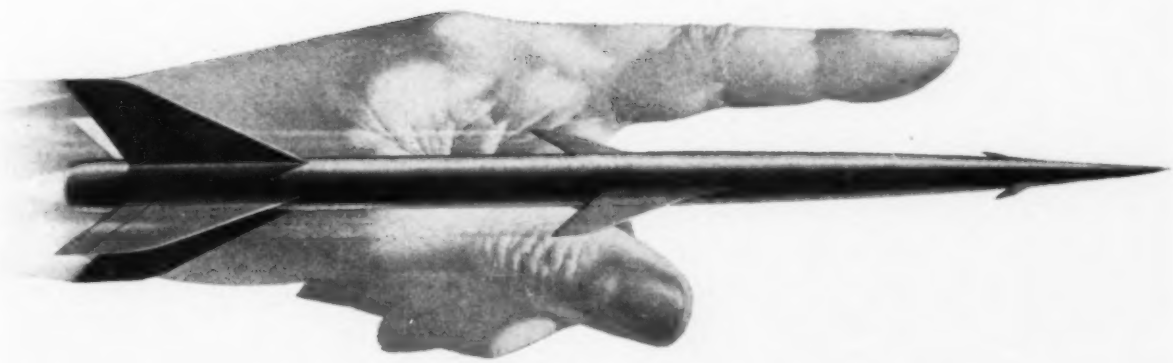
* * * * *

Following the disbandment of the R.N.V.R. air branch, No. 7 F.T.S.—which since 1954 has been the only advanced R.A.F. flying training school to train naval pilots on turbojet aircraft—will next year be merged with No. 1 F.T.S., Syerston, and both are to move to Lynton in Devon as No. 1 F.T.S.

G/C. R. H. C. Burwell, C.O. of R.A.F. Aldergrove, signing the roll of Freemen after the station had been elected an Honorary Burgess of the City of Belfast on October 5. To his left are the Lord Mayor (Ald. Cecil McKee) and the Town Clerk, and behind stand (from left to right) Air Marshal Sir Geoffrey Tuttle, the D.C.A.S.; Air Marshal Sir Bryan Reynolds, A.O.C.-in-C. Coastal Command; and A.V-M. P. D. Cracroft, who is A.O.C. No. 18 Group.

What next in the air? How high? How fast?

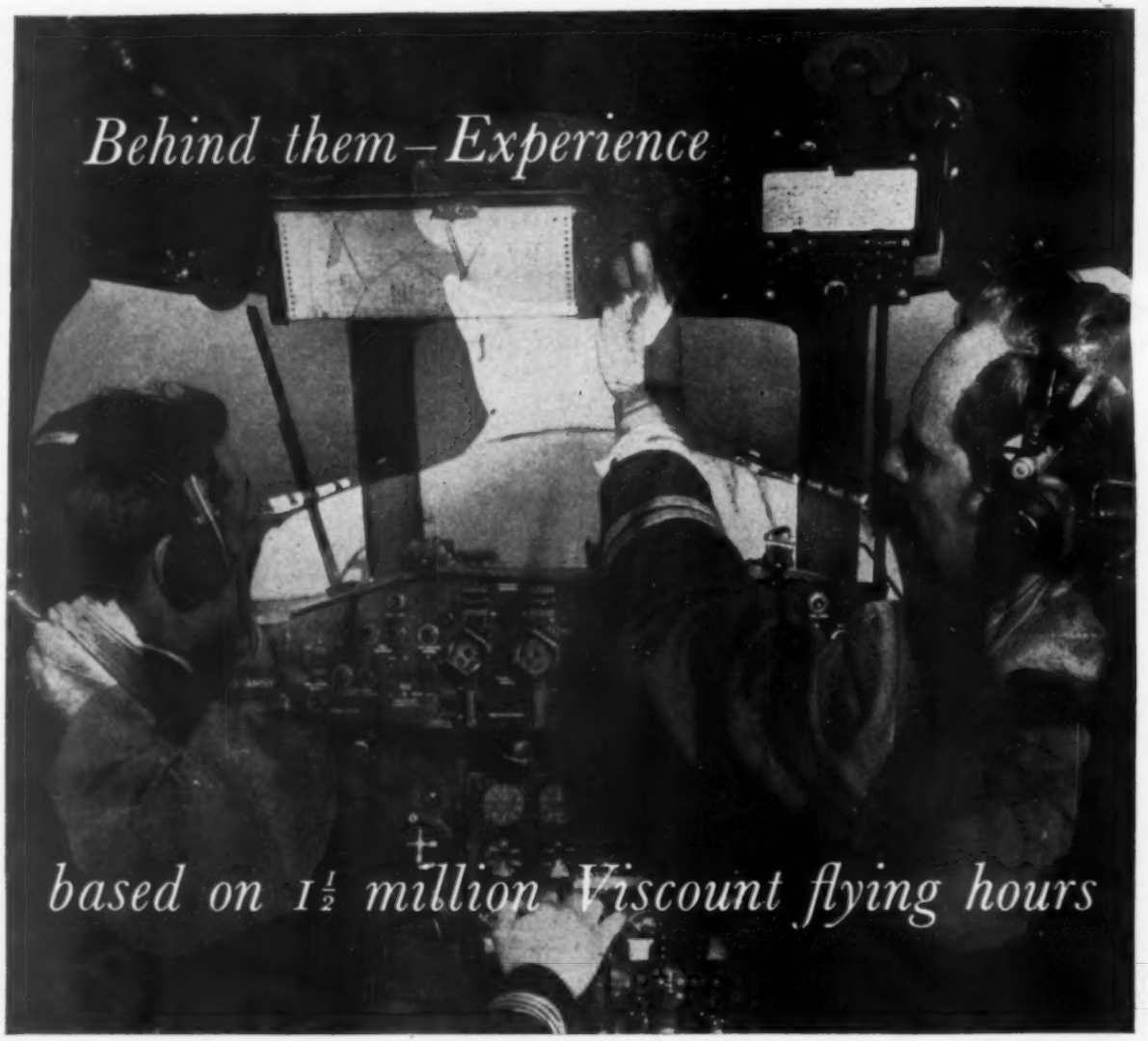
In meeting the demands for ever-increasing speed and altitude, the English Electric Aviation Group is tackling and progressively resolving the inherent problems of heating and cooling: for, apart from aerodynamic shape, future performance will be governed more and more by the ability of materials and components to endure a rapidly widening range of temperatures.
Whatever is to be the future of aviation, it is now being foreshadowed on the drawing-boards of English Electric, Marconi's and Napier—three famous firms sharing talents, experience and resources in the English Electric Aviation Group.



The projects on which we are now working are secret but our achievements speak for themselves—
English Electric produce the famous Canberra and supersonic P.1., and are now foremost in the development of Guided Weapons; Marconi's are pre-eminent in radar, radio and navigational aids; and Napier are renowned for experience in the design and production of gas turbines, ram jets and rocket motors.

English Electric • Marconi • Napier

THE BIG THREE WHO MAKE UP THE 'ENGLISH ELECTRIC' AVIATION GROUP



Aer Lingus Success

Mr. J. F. Dempsey, Director and General Manager of Aer Lingus, said recently, "Our fleet of Viscounts played a major part in the success of our twenty-first year of operation, enhancing both our prestige and our business. They have enabled us to provide our passengers with a higher standard of complete comfort and speed. Our salesmen have had something extra to 'sell' in the Viscount and as a result our traffic has shown a steady increase since we acquired these excellent aircraft."

Pilots have many reasons for preferring the Viscount with its proved and reliable non-powered flying controls.

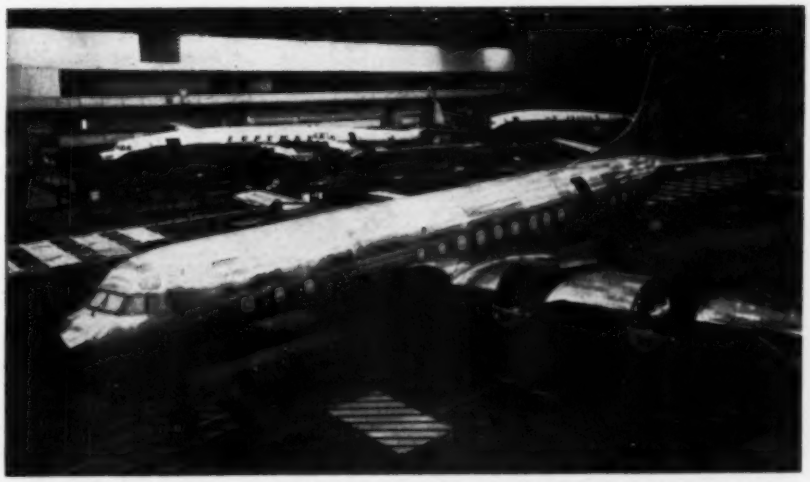
Viscount experience in service with over 20 airlines is being built into the simple functional cockpit and cabin layout of the new Viscount 810-840—ensuring for both pilots and passengers that comfort and freedom from strain which is now associated with Viscount travel. In this new Viscount the proved dependability of the airframe and the Rolls-Royce propeller-turbine, after ten years of development and 1½ million flying hours, means peace of mind for both crew and passengers. Quiet, smooth flight reduces fatigue and improves efficiency, while the rapid turnround due to ease of maintenance means less worry over schedules.

There is no substitute for experience

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED WEYBRIDGE SURREY

TGA AT648

CIVIL AVIATION



This new picture of the first Lockheed Electra shows that the Burbank plant means to achieve the first-flight target-date of January 31 next. Roll-out will be in December, certification in August 1958, and deliveries (to Eastern) will start in September 1958. Since this picture was taken the newly certificated Allison 501-D13 turboprops have been installed.

THE JETSTAR'S JETS

IT is encouraging to record that the Bristol Orpheus engines of Lockheed's JetStar are meriting praise from Marietta, where the aircraft was built. The "excellent performance" of the two Curtiss-Wright TJ-37s (imported Orpheus) during current flight testing (said Lockheed's Georgia Division sales manager, Robert I. Mitchell) may mean that a twin TJ-37 version would be offered as an alternative to a four-engined JetStar powered with General Electric J-85s or Fairchild J-83s. Previously the Orpheus had been intended for the prototype only.

Although the aircraft has been built primarily to meet a U.S.A.F. specification for a crew-readiness/jet utility trainer, sufficient inquiries from civil users have been received by Lockheed for the firm to start a waiting list for prospective purchasers.

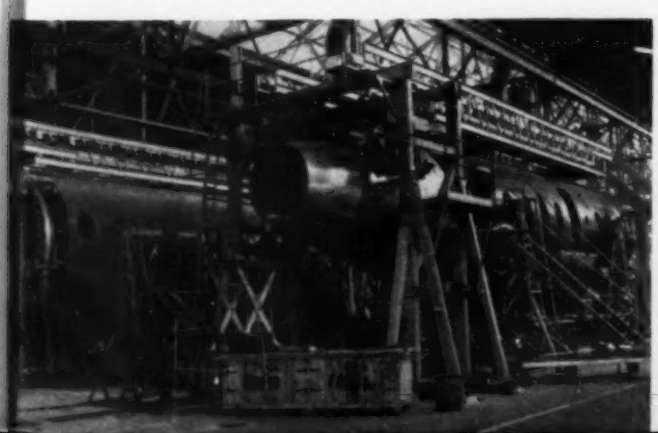
THE BRITANNIA AND THE TYNE

THERE were hints last week that a possible marriage between the Bristol Britannia and the Rolls-Royce Tyne was being arranged by the Ministry of Supply. Though it is natural that the Ministry, in its concern about the Proteus, should have given thought to the possibilities of re-engining the Britannia, the facts seem to be: (1) Neither of the alternative engines—Rolls-Royce Tyne or Bristol Orion—is likely to be available in quantity for at least a year. (2) Even if either engine were available, the first choice would be the Orion—firstly because it has been intended as a Britannia engine from the start (and has been flying as a Britannia powerplant), secondly because initial Tyne production is in any case earmarked for the Vanguard. (3) Re-engining would involve costly and time-consuming changes to the airframe. (4) There is no reason to doubt that the Proteus problems will yield to the immense technical effort being exerted on them.

For the record, the possibility of a Tyne-Britannia was studied some two years ago by Bristol in the routine course of project work.

The Ministry of Supply was associated with the Britannia in another way last week. In a letter to the Minister, Mr. Aubrey Jones, Mr. J. Matthews, who is secretary of the trade union side of the National Joint Council for Civil Air Transport, asked for a Government inquiry into the Britannia. Mr. Matthews is campaigning for more public control of the aircraft industry, and he suggested in his letter to Mr. Aubrey Jones that there should be a "pooling of resources." In a statement quoted in *The Times* he said that he had asked the Minister for an inquiry six weeks ago, but that "Mr. Jones did nothing. He said that he had no authority to interfere with the Bristol Aeroplane Company. I am not satisfied with that. His Ministry up to the end of 1956 handed over £18m for the aircraft. What I am interested in more than anything else is the position of B.O.A.C. They are losing hundreds of thousands of pounds because the Britannia is not a machine which they can operate to the full."

Mr. Matthews claimed that B.O.A.C. had to cannibalize aircraft to provide spares for the Britannias because of delay in getting parts from the manufacturers. "The planes fly late. That means revenue paying passengers are being driven to competitors . . . I think it is entirely foolish to pay all these sums of money to private industry and to have no control over how they spend it—and that is apparently the case."



At Weybridge are to be seen encouraging signs of Vanguard progress. The fuselage of the first aircraft (which Vickers said at the S.B.A.C. Display would fly "about this time next year") is seen in the picture. The centre section, to which these rear and forward sections will soon be joined, is similarly advanced, and the wing structure will soon be receiving its integrally milled skin panels. Deliveries to B.E.A. will start in March 1960, and to T.C.A. in August 1960.

PIONEERING ROUND-UP

FROM Aden, Austria, Spain and Mexico comes news of Scottish Aviation's Twin Pioneering activity around the world. Their development aircraft, G-ANTP, has undergone tropical trials from Asmara, Eritrea, and R.A.F. Aden, operating in tropical maximum temperatures of 113 deg F (I.S.A. + 30 deg C). The detailed results are now being plotted and will be incorporated in the flight manual in six weeks or so.

In September, a demonstration tour of Spain was made at the request of the Spanish airline, T.A.E. (who have three aircraft on order), and during this month a tour of Central American countries is to be made. Scottish Aviation's Mexican agents, Eumex, will handle the arrangements.

In New Guinea, an inquiry is being held into the loss on August 30 of one of de Kroonduif's three Twin Pioneers. Meanwhile, the other two aircraft (which were reported to have been grounded) remain in full operation. News from Austria is that a modified Twin Pioneer purchased by the air survey department of the Austrian Government was named last month. "In the opinion of experienced air survey pilots," said Dr. Karl Neumaier, the departmental head, "the Twin Pioneer is eminently suitable for air survey work."

PRESTWICK PREPARES FOR THE JET AGE

A CONTRACT for the lengthening and strengthening of Prestwick's main runway has been granted by the Ministry of Transport and Civil Aviation to Kings and Co., Ltd., of Glasgow. Work has started, and the main runway has been withdrawn from service pending completion next spring of a 500ft extension at the seaward end (bringing paved length to 7,500ft) and a 500ft stop-way at the landward end. Meantime, the subsidiary 6,000ft instrument runway, opened in 1955, will handle all traffic.

Cost of reconstructing the main runway will probably be not less than £250,000, but even so it will not be suitable for full-load DC-8 and 707 take-offs. The question of further extensions depends upon the intentions of the operators of these aircraft. So far, they have not made it clear what part Prestwick will play in the jet age. But it seems likely that if Scotland wants DC-8 and 707 services it will—like many other countries—have to face up to expensive runway construction work.

At the request of Mr. Aristotle Onassis (right), seen here with the French Deputy Minister of Commercial Aviation, the Caravelle was recently demonstrated to Olympic Airways in Athens. It is reported that Olympic are considering the purchase of a "considerable number" of Sud-Est Caravelles.

CIVIL AVIATION . . .

EXTRACTS FROM MILAN

HELD in Milan towards the end of last month was the third Franco-Italian "Leonardo da Vinci" Symposium on Aeronautics, organized jointly by the Institut du Transport Aérien, the Association Française des Ingénieurs et Techniciens de l'Aéronautique, the Associazione Italiana di Aerotecnica and the Centro per lo Sviluppo dei Trasporti Aerei. These symposiums take place every second year, alternately in France and in Italy. This year two papers were read, *The Problems Facing a Major Airline Through the Advent of Jet Aircraft*, by M. Louis Lesieux, and *Air Traffic Control and Co-ordination in Europe in the Jet Transport Age*, by Dott. Ing. Publio Magini.

In the first lecture the speaker reviewed his subject from the point of view of operating, industrial and economic problems, the future use of present equipment, and co-operation between carriers. Some salient points from his lecture were:—

"If timetables are to be kept as convenient as they commonly are at present, a reduction in aircraft utilization will have to be expected. In exchange for the shorter stage-times and greater comfort of four-jet transports, passengers will have to be willing to accept certain timetable requirements. It will be for the operators to work out a compromise between what they would like and what the passenger is prepared to accept."

"On long-distance routes lower flight time and additional comfort will weigh heavily in the balance against today's aircraft. The seat-mile cost of four-jet equipment, including depreciation, is likely to be about the same as that for amortized four-engine conventional aircraft. A differentiation of fares of the order required to be effective would lead to losses. As for the idea of making up such losses by raising fares on jets, it would amount to letting arbitrary considerations decide fare levels. It is my belief that as soon as four-jet aircraft are in sufficient numbers to cope with normal volume of traffic, piston-engined aircraft will be eliminated."

"Too much attention has been given to collective organization of intra-European transport in the vague hope that somehow or other this would lead to active co-operation over long-haul routes."

Quoting Stuart R. Tipton of the American A.T.A.—"We have almost run out of a precious natural resource, the air space itself"—Dott. Ing. Magini reviewed the inherent shortcomings of the European airways system and explained the plan put forward by the NATO Committee for European Air Space Co-ordination: "extension of the upper-limit of the existing airways network, or, creation above the existing airways network of a second one, the vertical separation between the two networks depending on the operational characteristics of piston-engine and turbine-powered aircraft. Vertical separation between aircraft flying within the upper airways could be 2,000ft and new quadrantal separation rules would have to be devised."

Sig. Magini also enumerated a number of other A.T.C. solutions, such as the reduction in lateral separation made possible by Decca and the three-co-ordinate high-power radar/television unit to be installed at the Melsbrook Area Control Centre by the Régie des Voies Aériennes Belges.

Opening the West London Air Terminal on October 8 by unveiling a plaque commemorating the occasion is Mr. Harold Watkinson, the Minister of Transport and Civil Aviation. A new car park —urgently needed — is to be opened soon and passengers' public-transport needs, he said, "can now be assessed."

MALAYAN AID

WHEN the Federation of Malaya became a sovereign State within the Commonwealth, Sir George Cribbett, deputy chairman of B.O.A.C., suggested that young Malayans should compete for a scholarship that would enable them to train abroad in air transport subjects for about three years. The Corporation (which is to increase its holding in the airline) has a close interest in the development of air transport in Malaya and would like to see a nucleus of Malayans fully equipped with technical and management knowledge.

Following a discussion between the Prime Minister of Malaya and Mr. D. E. Crum, B.O.A.C. sales manager for South East Asia, it has been agreed that the selection of the first two candidates will probably be made early in 1958 and that further selections, of two candidates at a time, would be made every subsequent second year for a period yet to be determined. After successful completion of the course, candidates will be offered permanent posts with either B.O.A.C. or Malayan Airways.

AIR FRANCE POLAR PLANS

SINCE T.W.A. inaugurated their trans-polar services between Paris and the U.S. West Coast with their L.1649A Jetstreams, Air France (who operate similar equipment) have frequently been asked why they did not follow suit. They do in fact intend to do so, and hope to add a trans-polar route to Los Angeles and San Francisco to their services in the near future. Beforehand, however (as M. Max Hymans, chairman of Air France, explained recently), the 1946 agreement between France and the U.S.A. must be differently interpreted. When it was formulated, polar flights between the Pacific coast and France were not envisaged and only specific cities in the U.S.A. were made available to Air France. Negotiations for reciprocity are now proceeding and—as M. Hymans added—"we have every reason to believe that they will be successful."

T.W.A.-NORTHWEST ROUND THE WORLD

IT has been announced that a new round-the-world service by Northwest Airlines and T.W.A. is due to start on January 1 next. This follows the C.A.B. award to T.W.A. extending the airline's foreign routes beyond India and Ceylon to Bangkok and Manila, where connection with Northwest is effected.

Starting points for round-the-world travel will be any of the cities along the North American transcontinental routes of Northwest and T.W.A.; the two networks combine at Chicago. Schedules will provide daily flights from New York; DC-7Cs and Super-G Constellations will be used. Westbound, Northwest's daily service goes to Seattle and across the Pacific to Tokyo, and from Tokyo three times weekly to Manila. T.W.A.'s daily service eastward from the U.S.A. provides flights to Rome and Athens and, twice-weekly, beyond Athens to Bombay, Colombo, Bangkok and Manila. Starting from Los Angeles or San Francisco, there is the Polar route alternative to Paris.

CROYDON FIGHTS ON

THE Croydon Chamber of Commerce, who have shouldered the responsibility of attempting to keep Croydon Airport open, have replied to a letter from the Ministry of Civil Aviation which set out their reasons for closing the airport. Reminding the Ministry of the terms of the Civil Aviation Act, 1945 (*"It shall be lawful for His Majesty to appoint a Minister of Civil Aviation who shall be charged with the general duty of organizing, carrying out and encouraging measures for the development of civil aviation, for the designing, development and production of civil aviation, for the promotion of safety and efficiency in the use thereof, and to research into questions relating to air navigation."*), the president of the Chamber, Mr. L. Halpern, said: "I do not think that there is any statutory authority to exclude private or charter aviation from the direction to the Minister to 'encourage' measures for the development of civil aviation."

The Chamber also put forward the extended free lane plan (*Flight*, September 27, 1957) as one possible solution to the air traffic control problem. The Court of the Guild of Air Traffic Control Officers, the reply adds, have said that it would take a considerable time to make a new plan to include Croydon. "This does not suggest that it is impossible, and if such a plan is to be prepared it is obviously essential to keep Croydon open whilst it is being done."

Croydon Council have appointed an *ad hoc* committee of investigation, with a view to asking the Minister to keep the airport open.

FINNAIR'S EQUIPMENT STUDIES

THE Finnish airline, Aero O/Y-Finnair, is one of the most recent European operators to study the offerings of the medium-range jet and turboprop market at first hand. The managing director, Mr. L. Grandell, and the technical director, Mr. B. Aulin, have visited France to study the Caravelle. Another technical team has visited de Havilland and a third has visited the U.S.A. Finnair were expecting a visit from Lockheed earlier this month. There is, however, no prospect of an immediate order being placed.

DART DC-6B?

FOR several years now Douglas have been studying possible ways of extending DC-6/7-series production by offering turboprop power. The best-known project is the DC-7D cargo aircraft, with Rolls-Royce Tynes, which has been officially announced by Douglas but for which, as yet, there have been no takers.

The latest news is that Douglas are re-examining the possibility of re-engining the DC-6B with Rolls-Royce Darts. This becomes feasible now that the Dart, in its RDa.10 form—giving 2,350 e.h.p.—is in sight (Rolls-Royce reckon on 1959 for this Dart variant to be available). Clearly, installation of Darts in the DC-6B, in place of the Pratt and Whitney R.2800 piston engines (2,400 s.h.p.) will confer many improvements, notably in basic weight. Though no Douglas figures are yet available, it appears that payload, not to mention speed, should be considerably increased.

NUCLEAR TRANSPORT

"FROM the information we have in hand, it appears that we can design a logistics airplane which incorporates a nuclear powerplant—and that it will work." This was stated in a paper presented by Robert W. Middlewood (Lockheed's chief engineer) and Robert B. Ormsby, Jr., at a National Aeronautic Meeting of the Society of Automotive Engineers in Los Angeles on October 2. The paper discussed some of the results of Lockheed's studies into nuclear-powered aircraft since preliminary work began in 1956. It would be possible, the lecturers said, to design a large transport using a nuclear reactor as an energy source to carry a "logistical payload" of 50 tons or more for distances of over 24,000 miles. Since the amount of energy released from a reactor, if utilized in a turboprop engine, will produce over three times as much thrust for take-off as it will in a turbojet, the nuclear-powered logistic transport would most likely be a turboprop, and would resemble the C-130 Hercules. It would probably have one reactor as the basic power source, though there is some possibility of two reactors. Shielding would be on the divided principle—some of it around the reactor and some of it around the crew compartment or other sensitive radiation areas—in order to reduce weight.

Design features of this type of aircraft would include easy loading and ability to use existing airfields and to carry all types of cargo; and no extensive ground handling facilities or large crews would be needed. One of the major problems to be resolved, Mr. Middlewood concluded, was in the weight of the shielding that would be required.

KANGAROO TALKS

TEN days of aviation talks in London between Britain and Australia were successfully concluded on October 4, with representatives on both sides of the table agreeing that air communications between the two countries should be maintained on an increasing scale.

The majority of the business was concerned with the terms of a comprehensive agreement between Australia and the U.K. covering an exchange of routes for the countries' international airlines, B.O.A.C. and Qantas. The well-established "Kangaroo" route between London and Australia *via* the Middle East has been "confirmed and amplified," and Qantas' hard-won new "Southern Cross" route across the Atlantic, North America and the Pacific is to be opened, the airline hopes, on December 6. There are to be two flights a week *via* New Caledonia, Fiji, American Samoa, Canton, Honolulu, San Francisco, New York, the Azores, Eire, the U.K. and beyond. Seven Qantas pilots are being sent to the U.S.A. to be trained for the San Francisco-New York sector. Under the terms of the new agreement, Australian airlines will be able to operate into London across the Pacific *via* North and Central America and across the Atlantic (including a Polar route), or an Atlantic route *via* South America and the South Pacific. Provision has also been made for services across the South Indian Ocean and between Australia and Hong Kong.

New arrangements have also been made to add Perth, Melbourne and Brisbane to the airports of Darwin and Sydney served by B.O.A.C. in Australia.

A recent visitor to Filton was the Hon. J. H. Whitney (right), U.S. Ambassador to the U.K. During a flight to L.A.P. in a Britannia 313, he discussed the aircraft with Mr. R. S. Brown (left), works director of Bristol Aircraft.

BREVITIES

B.E.A.'s services to Prague were renewed on October 7 when a Viscount 701 left London Airport for Ruzyne Airport at Prague. This was the first service since flights to Czechoslovakia were discontinued in 1951. B.E.A. Viscount flights to Tel Aviv were inaugurated on the same day.

* * *

Luxembourg has placed a £50,000 order with Cossor Radar and Electronics, Ltd., for CR 21 surveillance and approach-control radar.

* * *

The maintenance and flying training activities of the Airwork group of companies have been brought under the control of a new company, Airwork Services, Ltd. General manager is Mr. R. W. Cantello.

* * *

Mr. W. B. Lewis, M.A., B.Sc., A.M.I.Mech.E., A.F.R.Ae.S., has been appointed Assistant Director, Directorate of Civil Aircraft Research and Development, M.o.S. He was previously at R.A.E., Farnborough.

* * *

New offices for Sabena were opened at 36/37 Piccadilly, London, by Baron Moens de Fernig on October 11. At the shareholders' meeting in Brussels, it was announced that the airline had made a net profit of £553,000 in 1956-57.

* * *

Speaking at a luncheon in London, Mr. Harold Mansfield, Boeing public relations officer, said that "it would be interesting to see if the Russians could sell any of their jets or turboprops on a competitive basis . . . I don't think they could."

* * *

Indian Airlines Corporation inaugurated their first Viscount services on October 10 with a flight from Delhi to Rangoon *via* Calcutta. This service will be operated daily. Next year the Corporation will introduce Viscounts on trunk routes to Bombay, Calcutta, Madras, Hyderabad and Bangalore as well as Karachi, Colombo and possibly Kashmir.

Eight Herons are at work on Aviaco's Spanish network, the average stage length of which is 250 miles. Here, EC-ANX is serviced at Madrid —an operation which generally takes less than twenty minutes.

CLUB AND GLIDING NEWS

CONSTRUCTION of an improved version of the Tiger Moth which would "give the Stampe a good run for its money" was announced by Mr. Norman Jones, chairman of the Tiger Club, at the club's annual dinner in London on Friday last, October 11. This aircraft, which was being built by Rollasons at Croydon, would be called "The Bishop," in honour of the club's hon. secretary and C.F.I., C. A. Nepean Bishop. The club would not necessarily confine its future operations to the Tiger Moth, Mr. Jones disclosed; members were interested in "any little aeroplane which provides sporting flying." The club had had a successful year, and the chairman thanked members for their intelligent flying at the many events in which they had participated. One danger to the intelligent and careful pilot, Mr. Jones reminded members, was that of prosecution by the M.T.C.A. In the club's general plans for the coming year, a development in proficiency in what the French called *voltige*—which was more than mere aerobatics—would be encouraged.

Details of the club's plans for the 1958 season were given by C. A. Nepean Bishop, who mentioned a Tiger Club race meeting at Sandown on April 6-7 and an aerobatic competition for the de Havilland Trophy on May 3-4 at Sywell. The race meeting would be for the Basil Monks Trophy (Alderman Monks was among the guests at the dinner).

Among the Tiger Club's recent activities has been the development of glider-towing by members, and a further increase in the amount of such flying was forecast. A suggestion by the chairman that archery was the perfect way of spending ground time at an aerodrome was taken up and developed enthusiastically by those present at the dinner. Why not fit bows to the Tigers and cultivate aerial archery, asked Beverley Snook.

TROPHIES won by members of the Exeter Aero Club were presented at a pilots' supper on September 21. The Bennett Trophy for Airmanship went to an airwoman, Miss Marjorie Nitch; the Parkhouse Trophy for Navigation to Jack Ware; and the Unwin Trophy for the pilot of the year to Dennis King. The club's annual general meeting is planned for October 30.

LANCASHIRE AERO CLUB report the "wettest September since 1927," and its effect in reducing the monthly flying-hours total to 117. Successful pilots in recent contests were: Pemberton Landing Competition, H. Burrows; Rodman Landing Competition, J. A. Powers; Crossley Navigation Competition, F. M. Emery. The Hart Landing Competition, open to members of visiting clubs, was won by Mr. Formby of the Southport Aero Club. Forthcoming events at Barton include a chicken barbecue supper dance tomorrow, October 19.

LAST month's flying hours at the Scottish Aero Club, Perth, showed a seasonal decrease following a reduction in the amount of cadet flying (which amounted to 190 hours during August). Four club members and two cadets obtained P.P.L.s during the month, and the September competition was won by two lady members, Miss Saddler and Miss MacIntosh.

RECENT activities of the British Women Pilots' Association have included a successful flying meeting at Christchurch on September 28-29. Lunch on the Saturday was at Shoreham, and flights were made to Sandown, Isle of Wight, on the Sunday. The committee of the Association has been considering the problem of the employment of women pilots by the airlines, but has decided not to make a direct approach at the present time.

BY the end of last month, members of the Bristol Gliding Club had logged over 1,200 hours this year, flying from their permanent home at Nympsfield. The previous best post-war season gave a total of 700 hours, which was logged in 1955. Since moving from Lulsgate Bottom, average flight duration has increased, due largely to the improved soaring conditions of the Cotswold site. During September Peter Scott made the longest club cross-country flights since Derek Stowe flew 185 miles to Lands End. Flying solo in his T.42B Sea Eagle, Scott made 154 miles to Watton, near Norwich, and, five days later, he flew 131 miles to Colchester. He has now flown almost 1,000 cross-country miles since taking delivery of his sailplane last Easter, while the club total now exceeds 2,000 miles. An extensive programme of development of the club's ground facilities is planned for the next few months.

W/C. Arthur, A.F.C., chief flying instructor of Fair Oaks Aero Club (left) and Ron Cobbett, one of the club's instructors, with the Lennox-Boyd Trophy, which Fair Oaks gained as the most efficient club during 1955. A forthcoming dinner to honour W/C. Arthur is announced below.

FORTY years' flying is a considerable record; and to celebrate its achievement by their C.F.I., W/C. C. E. F. Arthur (as well as marking his 60th birthday), Fair Oaks Aero Club members and their friends are giving a dinner in his honour on November 8.

For twenty of those years W/C. Arthur has been the presiding genius—in varied manifestations—at Fair Oaks. He was C.F.I. when it was No. 18 (E. and R.) F.T.S. from 1937 to 1939; C.O. of No. 18 E.F.T.S. during the war; C.F.I. of No. 18 Reserve Flying School from 1947 to 1949; and has since then been chief instructor of the Aero Club, cheerfully and unpretentiously passing on the benefit of his vast experience.

In the time since he joined the R.F.C. in 1917 (after nearly three years with the Army), W/C. Arthur has flown 12,000 hours, mostly from the land but also off the water in seaplanes and "boats," and much of it in Canada, India and the Far East. He began flying in Maurice Farman Shorthorns, graduating (on Avro 504s) to Sopwith Pups and Camels; in the late 1920s, as a flying instructor with the R.C.A.F. he flew single-float Avro 504s, D.H.6s with twin floats and also the Vickers Vedette. With Indian National Airways he flew the D.H. Dragon, D.H. 60 and Avro 642; and for two years (1934-36) was C.F.I. at Rangoon Flying School.

The dinner-dance at which W/C. Arthur is guest of honour will be held at the Ardington Rooms, 315 Lavender Hill, London, S.W.11, at 7 for 7.30 p.m. on November 8.

FORTHCOMING EVENTS

Oct.	22.	R.Ae.S.: Section Lecture: "Aircraft Instrumentation for Flight-test Purposes," by R. R. Duddy and I. McLaren.
Oct.	23.	Kronfeld Club: "Trailer Building," by Tony Goodhart.
Oct.	30.	Kronfeld Club: "B.E.A.," by P. W. Brooks, B.Sc.(Eng.), A.C.G.I., A.F.R.Ae.S.
Oct.	31.	G.A.P.A.N.: "British Aircraft: Some Designers' Problems," by D. L. Brown, A.M.I.C.E., M.I.Mech.E., M.I.Gas.E., A.F.R.Ae.S.
Nov.	2.	British Interplanetary Society: "Conditions for Life," by Dr. J. W. S. Pringle, M.B.E., F.R.S.
Nov.	6.	Kronfeld Club: Talk by Phillip Wills.
Nov.	7.	R.Ae.S.: Graduates and Students Section: "Background to Aircraft Specifications," by K. W. Clark.
Nov.	8.	Helicopter Association: Discussion on: "The Problems Relating to the Installation and Operation of Radio Equipment in Helicopters." Introduced by D. W. Griffiths, M.S.I.A.E.
Nov.	12.	R.Ae.S.: Section Lecture: "Some Problems of Stability and Control," by H. H. B. M. Thomas, A.F.R.Ae.S.
Nov.	13.	Royal United Service Institution: "The Aircraft Designers' Dilemma," by Dr. G. V. Lachmann, F.R.Ae.S.
Nov.	13.	Kronfeld Club: Film Show.
Nov.	19.	R.Ae.S.: Section Lecture "The Supersonic Wind Tunnel," by Dr. W. F. Hilton, F.R.Ae.S.
Nov.	27.	British Institution of Radio Engineers: A.G.M.

R.Ae.S. Branch Lectures (to Nov. 13):—
Oct. 29, *Bascombe Down*, "Review of the Future Prospects of Fleet Aviation," by Rear Adml. D. R. F. Cambell. Oct. 30, *Southampton*, "Engineering Education," by Prof. A. R. Collar. Nov. 13, *London Airport*, Brains Trust.

A recent photograph of the Nelson Hummingbird auxiliary-powered sailplane taxying out under its own power prior to take-off at Livermore, California. The engine, a Nelson H-39 of 40 h.p., is retracted into the fuselage for soaring flight. Construction of the tandem two-seater is all-metal.

Fly in Europe's newest airliner...

PARIS
BRUSSELS
AMSTERDAM
COPENHAGEN
GENEVA
ZURICH
DUSSELDORF
FRANKFURT
DUBLIN
BELFAST
GLASGOW
NICE

BEA VISCOUNT 800 now serving 12 routes

You're favoured if you fly from London to any of the places on this list. Why? Because you can make the trip in a BEA Viscount 800. And that's something to look forward to.

No journey ever went so quickly, so smoothly, so pleasantly before. Two or three hours of air-conditioned comfort—time enough to enjoy a smoke, a duty-free drink, a delicious meal—and you're there, without a care on your mind, or a wrinkle in your suit!

With the Viscount 700 serving 30 destinations in Europe, you can now fly BEA Viscount to 42 destinations. Full details from your travel agent, any BEA office, or BEA, Dorland House, Lower Regent Street, London S.W.1 (Tel: GERrard 9833).

BEA VISCOUNTS FLY ALL OVER EUROPE

BUILT BY VICKERS POWERED BY ROLLS-ROYCE

BRITISH EUROPEAN AIRWAYS

SKYHI

Hydraulic
SERVICE AND SALVAGE
Aircraft Equipment

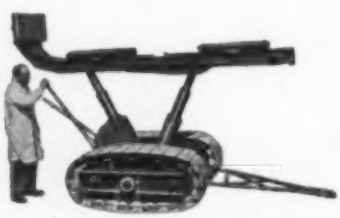
SKYHI
HYDRAULIC
AIRCRAFT
JACKS

Manufactured in various capacities and sizes from 2 to 30 tons. Three types of leg construction are available—Bipod, Tripod and Quadrupod. Hydraulic retractable transportation gear can also be supplied.

Skyhi Hydraulic Aircraft Jacks are standard equipment in the Royal Air Force and are used by most of the leading aircraft manufacturers. The unequalled specialised experience of Skyhi Engineers is always available to aircraft designers in meeting new lifting and moving problems.

SKYHI
TRACJACKS

Available for the quick clearance of runways and are uniquely useful when aircraft crash-land on soft ground. Completely self - contained mobile units. Capacities 10 tons and 20 tons.



SKYHI
AIRCRAFT SKATES

Specially designed for moving aircraft sideways. Where hangars are not wide enough to admit an aircraft head-on they enable the machine to be easily and quickly towed in sideways.

PLEASE WRITE for 16 pp. illustrated Booklet showing the complete range of Skyhi Aircraft Equipment

SKYHI LIMITED
SKYHI WORKS, WORTON RD.
ISLEWORTH, MIDDLESEX

Telegrams: SKYHIJACK, PHONE, LONDON Telephone: HOUNSLOW 2211/2/3

"Thermindex" Paints are temperature sensitive compounds which indicate by a sharp, clear-cut change of colour when temperature of a surface has attained or exceeded a predetermined value. They are supplied in the form of paints suitable for direct application by brushing or spraying to practically any surface and dry quickly at room temperature. When the temperature of the treated surface is then raised, the original colour of the pigment changes sharply at a definite point and the new colour persists after the surface has cooled down.

Write Dept. H/4, for full technical details.

Manufactured by Synthetics & Industrial Finishes Ltd.

"THERMINDEX"
TEMPERATURE INDICATING PAINTS

Sole distributors for Europe and U.K.

J. M. STEEL & CO. LTD.
36-38 KINGSWAY, LONDON, W.C.2 Tel. HOL 2332
BRANCHES: 45 Newhall St., Birmingham 3 Central 6342/3
51 South St., Manchester Deansgate 6077/9

Outstanding FLIGHT publications

"Each picture is worth framing"
Interavia

7s. 6d. net.
BY POST 8s. 6d.

FLIGHT FLYPAST

A Portfolio of Aircraft Photographs by "FLIGHT" Cameramen whose work is prized by enthusiasts throughout the world. This attractive collection contains an outstanding selection of their work, superbly reproduced, and includes 24 large plates printed on high quality art paper. 10½" × 12¼". 7s. 6d. net. By post 8s. 6d.

"Essential to the intelligent enthusiast and prospective technician"
Journal of the Royal Aeronautical Society

15s. net.
BY POST 16s. 3d.

FLIGHT HANDBOOK

By "FLIGHT" Staff.

This book is intended to meet the needs of aviation enthusiasts who require basic information on aircraft, engines and aeronautical theory. Illustrated by over 200 photographs and drawings, it provides a comprehensive picture of modern aviation in all its aspects, and no one concerned with flying in any way can fail to find it full of interest. 8¼" × 5¼". 282 pp. 5th Edition. 15s. net. By post 16s. 3d.

Obtainable from leading booksellers

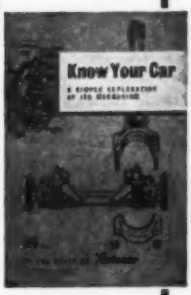
Published by "Flight" Dorset House, Stamford Street, London, S.E.1

Just out . . .

5s net
by post 5s 6d

Road performance reports on 15 British and foreign cars

Contains illustrated reports on the road performance of current British and foreign cars. This new edition, printed in photogravure, gives full details of some 15 cars, including many of the latest models. Illustrated by numerous photographs and diagrams.



3s 6d net
by post 3s 10d

A simple explanation of a car's mechanism

The 5th edition of KNOW YOUR CAR gives a simple, straightforward explanation of the mechanism of a modern car. Profusely illustrated with easy-to-understand drawings, it provides the novice driver with all the basic mechanical information about his vehicle that is needed.

from all booksellers

Published for "The Autocar" by Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1.

Comparatively speaking . . .

The difference between the new Bosch High Frequency Tools and ordinary electric or pneumatic tools is well-nigh incredible. High Frequency Tools have a better power weight ratio, are cheaper to install, cheaper to run, and safer.
The power loss, when many tools are running simultaneously off the same power source, is negligible compared with that of pneumatic tools.
There's a complete range of drills, polishers, screwdrivers, sanders and shears. Make your own comparison. Write to the address below, and we'll send you full details.

BOSCH

HIGH FREQUENCY ELECTRIC TOOLS

Details from U.K. Distributors:
SCINTILLA, LTD.
20 CARLISLE ROAD, LONDON, N.W.9
Colindale 8844

THE ENGLISH ELECTRIC
COMPANY LIMITED

AIRCRAFT DIVISION

DESIGNER DRAUGHTSMEN

with four or more years experience in any aspect of aircraft design are invited to apply for posts at Warton and Acton.

The Division is a strong, well-balanced team; a fact which has been amply demonstrated by the established success of the Canberra, and further emphasized by the reports on the P.1 in the Technical and National Press. Additional recruitment of experienced men for the drawing offices is now required to help our extensive long-term commitments.

The work available now, and for the future, is on advanced military aircraft, and a civil aircraft research team is now being established.

Excellent new drawing offices are being built at Warton and will be occupied shortly.

Apply, giving full details, to the
Chief Personnel Officer,
c/o Department C.P.S., Marconi House, 336/7 Strand, London, W.C.2,
quoting reference F 1799 E.

THE ENGLISH ELECTRIC COMPANY
LIMITED

AIRCRAFT DIVISION

ENGINEERS

are required for the flight test evaluation and development of the P1 B weapons system.

Applicants should have several years experience in the Aircraft Industry and possess an engineering degree or equivalent qualification.

A considerable number of these aircraft will be based at Warton for this and other interesting and advanced flight test work.

Apply giving full details of qualifications and experience to:

DEPT. C.P.S., 336/7, STRAND, W.C.2,
quoting Ref. F 1716B.

FLIGHT and AIRCRAFT ENGINEER

PRESS DAY — *Classified advertisement "copy" should reach Head Office by* FIRST POST THURSDAY *for publication in the following week's issue subject to space being available.*

CLASSIFIED ADVERTISEMENTS

Advertisement Rates. 5/- per line, minimum 10/-, average line contains 6-7 words. Special rates for Auctions, Contracts, Patents, Legal and Official Notices, Public Announcements, Public Appointments, Tenders 6/- per line, minimum 12/-. Each paragraph is charged separately, name and address must be counted. All advertisements must be strictly prepaid and should be addressed to FLIGHT Classified Advertisement Dept., Dorset House, Stamford Street, London, S.E.1.

Postal Orders and cheques sent in payment for advertisements should be made payable to Iliffe & Sons, Ltd., and crossed & Co.

Trade Advertisers who use these columns regularly are allowed a discount of 5% for 13, 10% for 26 and 15% for 52 consecutive insertion orders. Full particulars will be sent on application.

Box Numbers. For the convenience of private advertisers, Box Number facilities are available at an additional charge for 2 words plus 1/- extra to defray the cost of registration and postage, which must be added to the advertisement charge. Replies should be addressed to "Box 0000, c/o Flight," Dorset House, Stamford Street, London, S.E.1.

The Publishers retain the right to refuse or withdraw advertisements at their discretion and do not accept liability for delay in publication or for clerical or printer's errors although every care is taken to avoid mistakes.

AIRCRAFT FOR SALE

TRAVELAIR, LTD.
For Commercial Private Executive Aircraft

ANSON MK. I. 3,640 hours since new. 200 since check 5. Cheetah Nine engines, 202, 389 hours since new. Murphy 36-channel V.H.F. Bendix, A.D.F. range, fan marker. C. of A. March 1958. £1,200.

AUSTER V. 535 hours since new. Lycoming O/090/3 300 hours. 12 months C. of A. Murphy V.H.F. B/C 453 M.F. blind flying panel. Long-range tanks, etc. Excellent condition. £1,050.

DOVE. 8,542 hours since new. Gipsy Queen 70/4. 324/118 hours. STR. 9X, V.H.F. MR 80B. V.H.F. AD 7092, B/C 1033 C.B.A. Eight seats. £16,500.

FAIRCHILD ARGUS. 390 hours since new. Warner Super Scarab, 180 hours since new. C. of A. July 1958. Landing and navigation lights. Two spare engines. £1,050.

CHIPMUNK 22. 1,000 hours since new, nil hours engines, 3 years C. of A. £1,200.

PROCTOR IV. 1,050 hours since new, no engine hours, 4-channel V.H.F. 12 months C. of A. £485.

RAPIDE 2,800 hours since new. Gipsy Queen 3, 251/361 hours since new. 12 months C. of A. Plessey mult. V.H.F. Bendix A.D.F. fan marker, 2 generators. £2,700.

TRAVELAIR, LTD.
115 Oxford Street, London, W.1. GER 3382.
[0610

R. K. DUNDAS LIMITED

are privileged to offer a fleet of

DE HAVILLAND HERONS, SERIES I

CONSTRUCTED in 1953.

ENGINE hours on these aircraft range from 2,000-3,000 since new; nil—1,000 since overhaul.

AIRFRAME hours range from 3,000-3,800 hours since new; nil-1,000 since overhaul.

EQUIPMENT includes Marconi Radio, Smiths Instruments, 204 gallon capacity, nil hour engines can be supplied throughout at small additional cost.

THESE aircraft are offered "as is" at £20,000 each, excluding delivery.

R. K. DUNDAS, LTD., 59 St. James's Street, London, S.W.1. Tel.: HYDe Park 3717. Cables: "Dundas Aero," Piccy, London. [0559

LAMBERT BROTHERS, LTD.

offer for sale

SKYMASTER C54 A (E fuel system). Airframe hours 30,089 since new. Engines P & W.R-2,000. 2SD.13G. 58 Hardman seats. Complete de-icing system.

also

DH 114 MK 2 HERON Series II. Airframe hours 1,936 since new. Engines Gipsy Queen 30 Mk 2. 15 passenger seats. Complete de-icing system.

Telephone AVEnue 2000

or write 88 Leadenhall St., London, E.C.3

for full details. [7195

VENDAIR OF CROYDON AIRPORT

OFFER

GEMINI Mark IA. Airframe hours 1,050 since new. Cirrus Minor II engines 230 hours and 80 hours. V.H.F. radio. Recent C. of A.; aircraft in excellent condition. Price £1,900.

FIVE other aircraft in stock. Vendair, Croydon 5777. [0603

GEMINI III Gipsy Major 10s. Airframe 490 hours. Engines 212 and 574 hours since complete. 56-channel Murphy V.H.F. with crystals. Bendix M.N.26 radio compass. Lights. Fowler low drag flaps. Good loading characteristics. Single engine performance. New C. of A. £4,400. Edward Day, Spitzbrook, Marden, Kent. [7164

W. S. SHACKLETON LTD

Europe's Leading Aircraft Brokers
offer

PIPER TRI-PACER

Flown into the United Kingdom last year by its owner, formally imported, duty paid, and placed on the British register, C. of A. overhaul carried out by Auster Aircraft, Ltd., and now offered for immediate sale.

Only 441 hours on the airframe and engine since new, it is in beautiful condition. Equipment includes tricycle undercarriage, metal propeller, dual control, blind-flying instruments, engine silencers, electric starter, navigation lights, generator, Narco 12-channel V.H.F. radio, and cabin heating.

PERFORMANCE: Cruising speed 120 m.p.h. plus, range 500 miles, take-off—has to be seen to be believed, but it's better than the lift in our office!

A four-seat aeroplane with 50 lb. luggage capacity, it gives us great pleasure to offer this Piper Tri-Pacer for sale. Immediate delivery ex Derby or Elstree, £3,250.

W. S. SHACKLETON LTD.
175, Piccadilly, London, W.1.
CABLE: "Shackhud, London."
PHONE: HYDe Park 2448-9.

CROSS MFG. CO. (1938) LTD
COMBE DOWN, BATH
TEL: COMBEDOWN 2355/8

AIRCRAFT FOR SALE

£375 PROCTOR MkIII. New C of A, 4 seats, v. clean aircraft.—Box No. 2311. [7203

D. H. DOVE, Queen 70/4 engines. Available immediately. Channel Airways, Southend Airport, Essex. [0031

PIPER AIRCRAFT. Tri-pacers—Apaches—Super-Cubs. The sole agents for Great Britain and Ireland are Irish Air Charter Limited, 62 Merrion Square, Dublin. Tel. 63297. [0200

MILES FALCON VI G-AECC. Ideal fast touring aircraft, cruising 160 m.p.h. with three year C. of A. expiring 10.5.59. £900 o.n.o. Goodhew Aviation Co., Ltd., Oxford Airport, Kidlington, Oxford. Kidlington 3355/7. [7180

MILES GEMINI IA, airframe 1,039, engines 163 and 353. Full dual control including throttles, full blind flying panel, navigation lights, six-channel V.H.F. C. of A. until March 1960. £2,250. View London area. Consider high-class car in exchange. Box 2188. [7179

AIRCRAFT WANTED

W. S. SHACKLETON, LTD., are always in need of civil aircraft of all types to fulfil inquiries at home and overseas.

W. S. SHACKLETON, LTD., 175 Piccadilly, London, W.1. Cable: "Shackhud, London." Tel.: HYDe Park 2448-9. [0073

WANTED.—Good Gemini, well fitted, at approx. £1,750, or exchange almost new Lotus Climax 1100 sports racing car, complete with transporter, etc. Box No. 2205. [7187

AIRCRAFT ACCESSORIES AND ENGINES FOR SALE

MITCHELL AIRCRAFT, LTD.

A FEW Gipsy Major I engines (nil hours since complete overhaul) for delivery from stock. Apply Mitchell Aircraft, Ltd., The Airport, Portsmouth. Tel.: 717641. [0352

A.J.W. (INSTRUMENTS), LTD.

ALL types of aircraft instruments overhauled. Special test instruments made to your requirements. Particulars on request of our Magnetizer, Demagnetizer and Stroboflash—compact—efficient and inexpensive.

A.J.W. (Instruments), Ltd., Gatwick Airport, Horley, Surrey. Tel.: Horley 1420 and 1510 (Ext. 38, 105/6). [0268

ROLLASON AIRCRAFT AND ENGINES, LTD., CRO 5151. For all Tiger Moth, Gipsy Major, Gipsy Queen and Gipsy Six spares. Specialists in the overhauling of Gipsy engines. [0131

PHILLIPS & WHITE, LTD., offer from stock instruments and instrument parts. Navigational equipment, electrical components, airframe parts and hydraulic components and parts. Engine spares for de Havilland Gipsy Major and Queen series, also Armstrong Siddeley Cheetah IX, X, XV spares. Stock lists available. 61 Queen's Gardens, London, W.2. Tel.: Ambassador 8651, 2764. Cables: Gyrair, London. [0466

ENGINE Overhauls. Hants and Sussex Aviation Limited offer Britain's most comprehensive engine complete overhaul service, magneto overhaul service, and component and spares supply, De Havilland Gipsy range, Armstrong Siddeley Cheetah range, Cirrus range, Lycoming, Scarab and Continental. Most types available on exchange. Engines, components and spares shipped to all parts of the world. Address: The Airport, Portsmouth. Phone 73947. [0711

AIRCRAFT ACCESSORIES AND ENGINES WANTED

WANTED for export, surplus stocks AGS. components, 'Pip' release pins, etc. Also U.S.A. spares and components. Box No. 2206. [0260

SAMLESBURY ENGINEERING

AIRCRAFT CONSTRUCTORS

for all types of

C. of A. OVERHAULS
CONVERSIONS · REPAIRS
MODIFICATIONS

Designers and Manufacturers
of
JIGS and TOOLS
for the
LEADING AIRCRAFT MANUFACTURERS
Also
SUPPLIERS of MAJOR STRUCTURES, LARGE ASSEMBLIES and INTERIORS

A.R.B. Approved
Design & Drawing Office
Facilities Available

SAMLESBURY AIRFIELD
Nr. BLACKBURN, LANCASHIRE
TELEPHONE: BLACKBURN 44668
Also at
SQUIRES GATE AIRPORT, BLACKPOOL
STANSTED AIRPORT, ESSEX

AMERICAN K20 AIRCRAFT CAMERA
in fitted carrying case
F4.5 lens
£15 . 0 . 0

Films available. K24, F24, F52, K8AB and other cameras and all accessories available from stock write:—

Air Survey Dept.
Harringay Photo Supplies
423 Green Lanes - - London, N.4
MOUntview 5241/2

OUR HELICOPTERS FLY ALL OVER THE WORLD

Our fleet of helicopters is at your disposal anywhere in the world, any time.
We also run a training school for pilots and engineers on Bell 47 and Sikorsky S55 helicopters. Ask for further details from:

OSTERMANS AERO, STOCKHOLM 7, SWEDEN
Cables: Ostermanaero, Stockholm

The . . .
British Air Line Pilots Association
95 MOUNT STREET, W.1
Tel.: Grosvenor 6261

Membership open to all commercial and Service pilots. For full details concerning objects and particulars of membership please write to Secretary.

HELICOPTERS

HELICOPTER Charter. U.K. and Overseas. Autair, Ltd., 75 Wigmore Street, London, W.1. Telephone: Welbeck 1131. [0020

AIR PHOTOGRAPHY

MORSE Film Developing Units and Film Dryers; Continuous Film Printers; Argon and Mason Contract Printers; Water Supply Kits; Glazing Machines; F.24 Spiral and Spool Developing Outfits; K.17; F.52; F.49; and F.24 Cameras, Mounts, Lenses, Magazines, Controls, Vacuum Pumps, Motors and Spares for above Cameras; 16 m/m and 35 m/m Cameras, Projectors and Spares. Also large quantity of Aerial Film (all sizes). A. W. Young, 47 Mildenhall Road, London, E.5. Tel.: AMHerst 6521. [0290

AIR SERVICING

REPAIRS and C. of A. overhaul for all types of aircraft.—Brooklands Aviation, Ltd., Civil Repair Services, Sywell Aerodrome, Northampton. Tel.: Moulton 3251. [0307

BALL BEARINGS

NEW Ball and roller bearings, over 4,000,000 in stock in more than 4,000 types. Britain's largest stocks. Stock list available. Claud Rye, Ltd., 895-921 Fulham Road, London, S.W.6. RENown 6174 (Ext. 24). [0420

CAPACITY AVAILABLE

KELLERING and profile milling in all metals. Send us your die blocks to copy from wood or plaster masters. Up to 5ft by 8ft max. size. We are die copiers to the trade.
ARMYTAGE BROS. (KNOTTINGLEY), LTD., The Foundry, Knottingley, Yorkshire. Tel.: Knottingley 2046. [0975

CLOTHING

R.A.F. OFFICERS Mess Kit and No. 2 Dress purchased. Fishers', 86-88 Wellington Street, Woolwich. Tel.: 1055. [0567

CLUBS

HERTS AND ESSEX AERO CLUB, Stapleford Tawney Aerodrome. M.C.A. approved private pilot's licence course. Auster, Gemini and Tiger aircraft. Trial lesson 35s. 15 miles centre of London Central Line Underground to Theydon Bois, bus 250 to club. Open every day.—Tel.: Stapleford 210. [0230

CONSULTANTS

R. K. DUNDAS, LTD., have been giving the correct answer to aviation problems for twenty years. Technical. Purchasing Operations. Marketing. 59 St. James's Street, London, S.W.1. HYDe Park 3717. [0560

CONTACT LENSES

MODERN CONTACT LENSES CENTRE 7(D.1), Endsleigh Court, W.C.1. Deferred Terms. Booklet sent. [0342

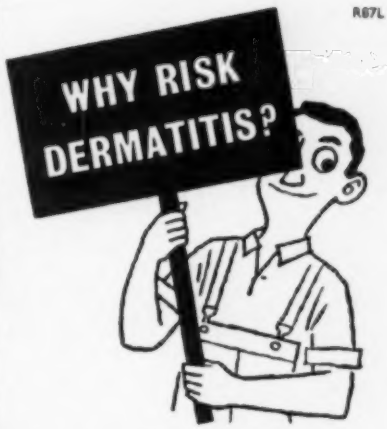
PACKING AND SHIPPING

R. AND J. PARK, LTD., 143/9 Fenchurch St., E.C. Tel.: Mansion House 3083. Official packers and shippers to the aircraft industry. [0012

PATENTS

THE proprietors of British Patent No. 711,929 for "Means For Controlling The Direction Of A Stream Of Ionised Fluid" desire to secure commercial exploitation by licence or otherwise in the United Kingdom. Replies to Tongue & Birkbeck, 329, High Holburn, London, W.C.1. [7182

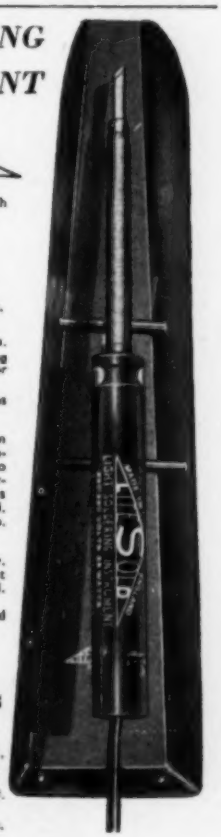
R67L



Lost hands or full production? Dermatitis—the cause of more lost man-hours than any other industrial disease—can be avoided simply by using Rozalex. For over 25 years Rozalex have specialised in barrier creams for industry. They have found the answer to most industrial skin irritants. The full technical resources and experience of Rozalex are at *your* disposal on request to Rozalex Ltd., 10 Norfolk Street, Manchester 2.

ROZALEX
BARRIER CREAMS

SOLDERING EQUIPMENT
by
LITESOLD



British made by British craftsmen.

- Light weight.
- Rapid heating.
- High efficiency.
- Unbreakable handle.
- Bit sizes 3/32 in. to 3/8 in. (In Copper or our long lasting "PERMABIT" or "PERMATIP" types.)
- All voltage ranges 6/7 v. to 230/250 v.

British and Foreign Patents. Registered designs. Suppliers to H.M. and Foreign Governments. Agents throughout the world. Write for Booklet No. S.15.

Illustrated is the 25 w. 3/16 in. replaceable bit model with safety shield.

Sole proprietors and manufacturers:—

LIGHT SOLDERING DEVELOPMENTS LTD.
106 George Street, Croydon, Surrey.
Telephone: CROydon 8589.
Telegrams: Litesold, Croydon.

PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE AIR TRANSPORT ADVISORY COUNCIL give notice that they have received the undermentioned applications to operate scheduled air services:—

FROM Silver City Airways, Ltd., of 1 Great Cumberland Place, London, W.1:—

APPLICATION No. 448/1 for an amendment to the terms of approval of the U.K. Internal Service which they are authorized to operate with DH.89A and DH. Heron aircraft on the route Stoke-on-Trent (Meir)-Guernsey and/or Jersey at a frequency of 10 return flights weekly from April to October each year until 7th April, 1962, so as to permit the service to be operated on the route Birmingham-Jersey at a frequency of four return flights weekly with Dakota aircraft initially from 1st May to 30th September, 1958, subject to the proviso that all passengers should first be carried between Stoke-on-Trent and Birmingham by coach transport of the Potteries Motor Traction Co., Ltd.

APPLICATION No. 630/2 for an amendment to the terms of approval of the seasonal U.K. Internal Service which they are authorized to operate with Dakota, Bristol 170 and Heron aircraft on the route Leeds (Yeadon)-Blackpool (Squires Gate) (optional technical stop)-Isle of Man (Ronaldsway) at a frequency of six return flights daily from April to October inclusive each year until October, 1961, so as to permit the operation of 10 return flights daily on Saturdays from June to September inclusive each year.

APPLICATION No. 131/3 for an amendment to the terms of approval of the U.K. Internal Service which they are authorized to operate with Dakota, Bristol 170 and DH. Heron aircraft on the route Blackpool (Squires Gate)-Isle of Man (Ronaldsway) at a frequency of 24 return flights daily until 31st December, 1959, so as to permit the operation of 30 return flights daily on Saturdays during July and August each year and also on Senior T.T. Race Days.

APPLICATION No. 790/2 for an amendment to the terms of approval of the U.K. Internal Service which they are authorized to operate with Dakota and DH. Heron aircraft on the route Blackpool (Squires Gate)-Belfast (Nutts Corner) with an optional technical stop at Isle of Man (Ronaldsway) on three return flights each Friday, Saturday and Sunday from end-June to beginning-September each year, until 31st August, 1963, so as to reduce the number of stops at the Isle of Man to a total of 6 return flights on Fridays-Sundays inclusive, with not more than 3 stops on any one of these days, and to allow the operation of Bristol 170 aircraft in addition to the types already authorized.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on 30th July, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [7197

TENDERS

AIR MINISTRY invite tenders for the purchase of some 1,650 Back-type parachute assemblies located at Carlisle. Apply immediately to Air Ministry, C.19a, Turnstile House, London, W.C.1 for form of tender. [7201

TUITION

AIR SERVICE TRAINING

The only fully equipped private School of Aviation. Specialist staff, comprehensive equipment and full residential and recreational facilities within the School ensure the soundest training for an aviation career.

M.T.C.A. APPROVED COURSES

for private and commercial pilots' licences and maintenance engineers' licence in categories "A" and "C".

HELICOPTER COURSES

for private and professional licences. Details available from the Commandant.

AIR SERVICE TRAINING, LTD.

Hamble, Southampton. Tel.: Hamble 3001/9. [0970

FREE! Brochure giving details of courses in all branches Aero Engineering covering A.F.R.Ae.S., M.C.A. exams, etc. Also courses for all other branches of engineering. Write: E.M.I. Institutes, Dept. F26, London, W.4. (Associated with H.M.V.) [0964

MARSHALL

AIRPORT WORKS CAMBRIDGE

DESIGN and DRAWING OFFICE

PUBLICATIONS SECTION

REQUIRE

MECHANICAL AUTHORS

TECHNICAL AUTHORS

TECHNICAL ILLUSTRATORS

Ex R.A.F. W/O. or N.C.O. Fitters (AIRFRAME & ELECTRICAL (AIR)) with a flair for Publication Work are invited to apply for vacancies offering

GOOD CAREER PROSPECTS.

Apply in writing, giving full details of Experience and Convenient dates for interview to

PERSONNEL MANAGER

SUBSTANTIAL SALARY

with superannuation

is offered to a

TOP-LEVEL EXECUTIVE

for an

AIRCRAFT FACTORY

engaged principally on overhaul and repair work. Applicants should be capable of assuming overall control and must have a good engineering background. Previous experience in the aircraft industry in an executive capacity is essential.

Box No. 2310, c/o FLIGHT

MINISTRY APPROVED COURSES FOR

COMMERCIAL PILOT — INSTRUMENT RATING

All subjects for professional licences and ratings including Academic, Technical, simulated and practical flying. Home Study excellent alternative.

- Individual coaching
- Refresher Courses
- Officially appointed by the Institute of Army Education for Forces Correspondence Scheme

Full details from your Resident Education Officer, or

London School of Air Navigation Ltd.

31 Crompton Rd., Knightsbridge, London, S.W.7

KEN 8221 Flying Base: Croydon Airport

AIRCRAFT SPRING WASHERS

TO B.S. SPECIFICATION S.P.47

CROSS MFG. CO. (1938) LTD., COMBE DOWN, BATH

TUITION

CIVIL PILOT/NAVIGATOR LICENCES

AVIGATION, LTD., provides full-time, or intermittent instruction and postal tuition, or a combination of any of these methods to suit individual requirements for the above licences. Classroom instruction can be provided for A.R.B. General, certain Specific Types and Performance Schedule examinations. Link Training Dept., at MONarch 1364. FOR full details apply to The Principal.

AVIGATION, LIMITED

30 Central Chambers, Ealing B/Way, London, W.5. Tel.: Ealing 8949. [0243

A SUCCESSFUL career for your son.

AERONAUTICAL, technical and practical training for all branches of aeronautical engineering. Diploma course leads to executive appointments in civil aviation design and development, draughtsmanship, maintenance, etc. Extended courses to prepare for A.F.R.Ae.S. and A.M.I.Mech.E. examinations. Write for prospectus to Engineer in Charge, College of Aeronautical Engineering, Chelsea, London, S.W.3. FLAxman 0021. [0019

SURREY Flying Club, Croydon Airport, M.C.A. approved for private pilots' licences. Open seven days a week. Croydon 7744. [0293

A.F.R.Ae.S., A.R.B. Certs., A.M.I.Mech.E., etc., on "no pass, no fee" terms. Over 95 per cent successes. For details of exams, and courses in all branches of Aeronautical work, Navigation, Mechanical Engineering, etc., write for 144-page handbook—free.—B.I.E.T. (Dept. 702), 29 Wright's Lane, London, W.1. [0707

LEARN to fly, £30; Instructors' Licences and Instrument flying, for £3 10s. per hour. Night flying £5 per hour. Residence 6 guineas weekly. Approved M.C.A. Private Pilot's Licence course. Specialized course for Commercial Pilot's Licence.—Wiltshire School of Flying, Ltd. Thruxton Aerodrome (Andover Junction 1 hour 15 minutes from Waterloo), Hants. [0253

SOUTHEND-ON-SEA Municipal Air Centre and Flying School. Comprehensive training for all pilots' licences, ratings and endorsements. Special facilities for instrument, night-flying and commercial pilot licences. Chipmunk aircraft. Link training to full instrument rating standard. No entrance fee or subscriptions. M.T.C. approved 30-hour course. Municipal Airport, Southend-on-Sea, Essex. Rochford 56204. [0453

AGENTS

THE TIGER MOTH SPECIALISTS are still Rollason Aircraft and Engines, Ltd., of Croydon Airport. Tel.: CRO. 5151. [0134

SITUATIONS VACANT

SENIOR STRESSMEN

REQUIRED for interesting programme of project and development work.
PREVIOUS experience essential, H.N.C. minimum qualification.
SALARY in accordance with experience and qualifications. Superannuation scheme.
EXCELLENT working conditions. Speedy contract transport operates from Bournemouth area to the airfield.
FULL particulars in writing to Personnel Manager, Flight Refuelling Ltd., Tarrant Rushton Airfield, Blandford, Dorset. [7194

TECHNICAL Illustrator (Senior). Harrow District. Opportunity for first-class man. Box No. 2295. [7198

STAFF Pilot with jet experience required. Apply: Chief Pilot, Airwork, Ltd., R.N.A.S. St. Davids, Pembs. [7171

LOUIS NEWMARK, LTD., have the following vacancies at their Development Laboratories at New Addington, Croydon, Surrey.
ENGINEER for work on the design and development of Helicopter Autopilots.
FLIGHT Test Engineer for preparation of Flight Test schedules and analysis of flight records.
DEVELOPMENT Engineer for work on instruments for G.W. applications.
SERVICE Engineer.

CANDIDATES should possess a degree or equivalent qualification and/or have had some previous industrial experience in the field of electromechanical or servo instruments. Pension Scheme. Apply in writing to the Personnel Officer, Louis Newmark, Ltd., Purley Way, Croydon, Surrey. [7169

AIRCRAFT Radio Engineer, with or without a licence, required by B.K.S. Engineering, Ltd., Southend Airport, Essex. Tel.: Rochford 56496. Apply to the Chief Radio Engineer. [7191

THE MULLARD RADIO VALVE COMPANY LIMITED

PROGRESS IN ELECTRONICS

TELEVISION PICTURE TUBES, TV COLOUR DEVELOPMENT, RECEIVING VALVES, GAS-FILLED VALVES, SEMI-CONDUCTORS

The Company is now able to **offer a limited number** of opportunities to young applicants who seek a progressive career with a leading organisation. Applicants must possess, or be studying for, G.C.E. "O" level; O.N.C. or H.N.C. (Elect. or Mech.); City and Guilds.

In addition there are a few posts available for **Ex-Service Personnel** with suitable experience (e.g., Radar/radio Mechs.).

Selected applicants will be employed as **ENGINEERS, TECHNICAL ASSISTANTS** or **DRAUGHTSMEN** in Production, Technical or Development Departments.

A feature of employment is progressive technical training and facilities for further study. Commencing salaries are necessarily dependent upon qualifications, age and experience and are considered liberal.

Good holiday provisions, pension and sickness schemes have been long established. Applications stating preference for type of work, qualifications, etc., should be addressed to the

Personnel Officer,
THE MULLARD RADIO VALVE CO. LTD.,
NEW ROAD, MITCHAM JUNCTION, SURREY,
quoting reference JFG/S.17.

BEA

BRITISH EUROPEAN AIRWAYS

require

LICENSED AIRCRAFT ENGINEERS

who possess 'A' and/or 'C' licences on modern transport aircraft, to act as Outstations Engineers in the U.K. and on the Continent.

Considerations given to applicants who have had maintenance experience on

(a) *aircraft currently operated by the Corporation;*

(b) *Constellation 749 and 1049 or Argonaut aircraft.*

Salary £907 to £1,039 p.a. plus appropriate allowances on posting, including additional payments for wife and children and education allowances for children where applicable.

Applications to

Senior Personnel Officer,
Area and Outstations,
BRITISH EUROPEAN AIRWAYS
Keyline House, Ruislip, Middlesex

AIR CHARTER

LIMITED

have vacancies for

TEN CO-PILOTS

on a permanent staff basis for their

SUPER TRADER
SKYMASTER and
BRISTOL fleet

Minimum qualifications:

Commercial Pilots' Licence and Instrument rating

Apply to:

The Chief Pilot
AIR CHARTER LTD.
21 Wigmore Street
London, W.1

SITUATIONS VACANT

AIRCRAFT Engineer with 'Hermes' A & C endorsement required by an Independent Operating Company for duty at Karachi. Salary and allowances amounting to £3,000 per year and car provided. Box No. 220. [7186

EXPERIENCED Woman Pilot required, Commercial Licence preferable, for interesting job in U.K., combining flying and administrative work. Salary £500 p.a. Write giving details and experience to Box No. 2296. [7199

REPRESENTATIVE required with good contacts and sound knowledge of aircraft instruments and ancillary equipment for large aircraft surplus stockists. Must be able to organize and control complete sales. Minimum salary £1,000 per year. Box No. 2292. [7196

ENGINEERS for work at Wolverhampton Airport, preferably licensed on Dakota and/or Pratt and Whitney, but others considered, for positions offering good prospects to right men. Accommodation available if necessary. Apply, The Manager, Don Everall (Aviation), Ltd. [7193

AIRCRAFT, like humans, need personal care and attention, and this must be administered only by those suitably qualified. If you are one such person and are keen to maintain a small family of working-class aeroplanes in sound health, there may be a practice awaiting you. To find out, ask the Chief Instructor at Elstree Aerodrome, Herts. [7183

RADIO Engineer required for London Airport. Candidates must be familiar with radio equipments installed on modern American airliners, preferably on Super Constellation aircraft. Salary according to qualifications. Apply immediately to Station Engineer, Pakistan International Airlines, 45 Piccadilly, London, W.1. [7190

HANDLEY PAGE (READING), LTD., The Aerodrome, Woodley, Reading, have vacancies for Senior and Intermediate Draughtsmen for interesting work on Civil Aircraft. High commencing salaries are offered and a generous Life Assurance and Superannuation Scheme is in operation. Please send full particulars of experience, etc., to the Personnel Officer. [0284

DESIGN and Detail Draughtsmen, preferably with aircraft experience, required for Weapons Research Design Office. All applications treated confidentially and interviews arranged to suit applicants. Excellent working conditions in new offices near Harrow-on-the-Hill underground station. Apply Administrative Manager, A. V. Roe & Co., Ltd., 2 College Road, Harrow, Middlesex. Harrow 8431. [7161

HANDLEY PAGE (READING), LTD., The Aerodrome, Woodley, have a vacancy in their design office for a senior aerodynamicist who will also act as assistant to the chief aerodynamicist. Applicants should have a degree and several years' practical experience. Successful applicant will be offered a house to rent and assistance will be given towards removal expenses. Please send full particulars of experience to the Personnel Officer. [0286

JUNIOR AND SENIOR DRAUGHTSMEN required for interesting work on pipe-line fittings and valves for high pressures. Increased demand for special purpose equipment creates one or two vacancies for keen intelligent men with appropriate experience. Pension Fund, Canteen, Sports and Social facilities. Please apply for interview to Ref. FKM., British Ermeto Corporation Ltd., Maidenhead, Berks. Tel. No.: 2271. [7202

AERODYNAMICIST. A new guided weapons team offers a senior position to an aerodynamicist with at least two years' experience in subsonic and supersonic work. The problems he will face involve initially assessment of performance and stability, and reduction of test data, but can lead to wider experience of all aspects of missile design. Please write to Box A.C. 34176, Samson Clarks, 57/61 Mortimer Street, W.1. [0287

HANDLEY PAGE (READING), LTD., The Aerodrome, Woodley, Reading, have vacancies for Senior Stress Engineers, with wide practical experience, for interesting work on Civil Aircraft. High commencing salaries with new houses to rent will be offered to those appointed. Life Assurance and Superannuation Scheme in operation. Please send full particulars of experience, etc., to the Personnel Officer. [0285

B.E.A. require Flight Administrative Officer at London Airport, for flying staff administration, preparing flying rosters and applying mandatory requirements. Qualifications: Extensive administrative experience. Good knowledge of M.T.C.A. regulations. Previous flying experience advantageous. Pension scheme. Air travel concessions. Salary £910—£1,085 per annum, according to qualifications and experience. Written applications, giving full details, to Senior Personnel Officer (E & S), Flight Operations Department, British European Airways, Keyline House, Ruislip, Middlesex. [7189

B.E.A. require an Establishments Planning Officer in their Flight Operations Department, for the preparation of crew schedules; integrations and the determination of short and long term pilot establishments. Qualifications: previous scheduling experience; the ability to carry out studies of a statistical and analytical nature; and a marked degree of initiative. A University Degree or its equivalent would be an advantage. Salary £910—£1,250 p.a. according to qualifications and experience. Apply to Senior Personnel Officer (E & S), Flight Operations Department, British European Airways, Keyline House, Ruislip, Middlesex. [7188

SITUATIONS VACANT

ENGINEERS capable of dealing with aircraft maintenance problems. Preferably with experience of aircraft industry or with R.A.F. or R.N. service. The vacancy is pensionable and train fares for applicants from outside the London area will be paid if required to attend for interview. Apply in writing to the Personnel Officer, Sir George Godfrey & Partners, Ltd., Hampton Road West, Hanworth, Middlesex, giving full details of experience, other qualifications, age and salary required. [7181

SITUATIONS WANTED

YOUNG man aiming for C.P.L. seeks any form of assistance, furtherance of hours, etc., on repayment basis. Box No. 2297. [7200

VICKERS-ARMSTRONGS
(AIRCRAFT) LIMITED
WEYBRIDGE, SURREY

have vacancies for qualified technical staff, such as:

INTERIOR DESIGN ENGINEERS
DRAUGHTSMEN

on furnishing, mechanical and electrical design and design modification.

STRESSMEN AND WEIGHTMEN
AERODYNAMICISTS
DEVELOPMENT ENGINEERS
(Mechanical and Electrical Test)

and other technical occupations applicable to work on the design, production and development of military and civil aircraft.

Previous aircraft experience is desirable but not essential in all cases.

Applications, quoting date of advertisement and prefix letter "h" to:
Employment Manager,
Vickers-Armstrongs (Aircraft), Ltd.,
Weybridge Works,
Weybridge, Surrey.

SITUATIONS WANTED

EX-AIRLINE Pilot, qualified instructor, 41 years, 9,000 hours world-wide flying, clean record, desires interesting flying. Reasonable terms. Apply Box No. 2208. [7185

PILOT, 22, CPL, two years Air Force experience, seeks position in aviation to satisfy enthusiasm. Anything considered, go anywhere. Box No. 2209. [7184

P.P.L. holder seeks position temporary or permanent, giving opportunity to obtain CPL. Anything considered. Go anywhere, anytime. Box No. 2248. [7192

EX-FLIGHT-LIEUTENANT, 1,600 hours, on single and twin-jets, B.Sc.(Pure Science), seeks post aircraft industry, England/Europe; knowledge French/German. Box No. 2129. [7168

BOOKS

ENGLAND'S only aviation bookshop. Send 3d. for 14-page catalogue or call Saturday. Beaumont, 2a Ridge Avenue, Winchmore Hill, London, N.21. [0620

"RALLIES and Trials," by S. C. H. Davis of "The Autocar." Describes in a colourful style the author's many adventures whilst driving in rallies and trials in all parts of Britain and Europe. The Monte-Carlo Rally, the exciting Alpine Trials and many other spectacular events are recalled by this world-renowned racing driver. 15s. net from all booksellers. 16s. by post from Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1.

"ABACS or Nomograms," by A. Giet. Translated from the French by H. D. Phippen and J. W. Head. Most engineers have made use of nomograms at some time in their careers, and are fully alive to the fact that they are a very convenient tool when the same formula has to be solved repeatedly for several sets of variables. It is fair to say, however, that only a small proportion of even those who habitually employ nomograms know how to construct them for their own use. Most of the comparatively small literature on the subject is written for mathematicians and is extremely difficult for the practical engineer to comprehend. This book is esentially practical, and not only demonstrates the many and varied applications of the abac or nomogram, but shows how even those without highly specialized mathematical knowledge may construct their own charts. 35s. 0d. net from all booksellers. By post 36s. from the publishers: Iliffe & Son, Ltd., Dorset House, Stamford Street, London, S.E.1.

BOOKS

"CELESTIAL Navigation for Yachtsmen," 3rd Edition. By M. Blewitt. This little book, intended especially for beginners, should receive a very warm welcome from every yachtsman who has wanted to learn the art of navigation by the heavenly bodies, but has been deterred by its apparent complexity. In particular, it will make an immediate appeal to all who feel their mathematics are not up to standard, for neither geometry nor trigonometry play any part in the author's explanation—indeed, even those who can manage little more than addition and subtraction should master the book with ease! 64 pages. Illustrated with 26 diagrams and graphs. Price 6s. net. By post 6s. 6d. from all booksellers, or Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1.

MARSHALL
AIRPORT WORKS CAMBRIDGE

VACANCIES AT CAMBRIDGE
for
SKILLED AERO ELECTRICIANS

Required for installation and testing Electrical Systems in Civil and Service Aircraft. Also

SKILLED AIRFRAME FITTERS

Good Average Earnings.
Single Lodging Accommodation Available.
Write, Call or Phone:
Cambridge 56291—Ext. 36
EMPLOYMENT OFFICER

BROOKLANDS AVIATION LIMITED
require
AIRCRAFT ELECTRICIANS
with experience on CANBERRA AIRCRAFT

PIECEWORK BONUS — CANTEEN FACILITIES

Apply in first instance to:—
No. 2 SITE, BUTTOCKS BOOTH, MOULTON, NORTHAMPTON

INDEX TO ADVERTISERS

	Page
Air Charter, Ltd.	31
Armstrong Whitworth Aircraft, Ltd., Sir W. G.	Facing Edit. Page 607
Automotive Products Co., Ltd.	Cover ii
Bellman Hangars, Ltd.	6
Boulton Paul Aircraft, Ltd.	1
Box No. 2310	30
Bristol Aircraft, Ltd.	Cover iv
British Air Line Pilots Association, Ltd., The	29
British European Airways	25, 31
Brooklands Aviation, Ltd.	32
Burnley Aircraft Products, Ltd.	4
Cross Manufacturing Co. (1938), Ltd.	28, 30
De Havilland Engine Co., Ltd., The	Facing Edit. Page 606
Dunlop Rubber Co., Ltd.	19
English Electric Co., Ltd. The	23, 27
Fairey Aviation Co., Ltd., The	Facing Edit. Page 614
Ferranti, Ltd.	7
General Electric Co., Ltd., The	8
Gloster Aircraft Co., Ltd.	Facing Edit. Page 626
Harringay Photo Supplies	29
Hong Kong Aircraft Engineering Co., Ltd., The	8
Hunting Percival Aircraft, Ltd.	Facing Edit. Page 622
Imperial Chemical Industries, Ltd.	9
Iliffe and Sons, Ltd.	26, 27
Light Soldering Developments, Ltd.	29
London School of Air Navigation	30
Marshall's Flying School, Ltd.	30, 32
Martin-Baker Aircraft, Ltd.	Facing Edit. Page 615
Mullard Radio Valve Co., Ltd.	31
Napier and Son, Ltd., D.	10
Northern Aluminium Co., Ltd.	Cover iii
Osterman's Aero	29
Palmer Tyre, Ltd., The	5
Peto and Radford	20
Republic Aviation Corpn., Ltd.	3
Roe and Co., Ltd., A. V.	14
Rolls-Royce, Ltd.	13
Rotax, Ltd.	Facing Edit. Page 627
Rotol, Ltd.	Cover i
Rozalex, Ltd.	29
Samlesbury Engineering, Ltd.	29
Scintilla, Ltd.	27
Shackleton, Ltd., W. S.	28
Skyhi, Ltd.	26
Steel and Co., Ltd., J. M.	26
Teddington Aircraft Controls, Ltd.	4
Titanine, Ltd.	2
Vickers-Armstrongs (Aircraft), Ltd.	24, 32
Venner Accumulators, Ltd.	6
Wakefield and Co., Ltd., C. C.	Facing Edit. Page 623

Printed in Great Britain for the Publishers, ILIFFE & SONS LTD., Dorset House, Stamford Street, London, S.E.1, by SUN PRINTERS LTD., London and Watford, Herts. *Flight* can be obtained abroad from the following: AUSTRALIA AND NEW ZEALAND: Gordon & Gotch, Ltd. INDIA: A. H. Wheeler & Co. CANADA: The Wm. Dawson Subscription Service, Ltd., Gordon & Gotch Ltd. SOUTH AFRICA: Central News Agency, Ltd.; Wm. Dawson & Sons (S.A.), Ltd. UNITED STATES: Eastern News Co., 306 West 11th Street, New York 14

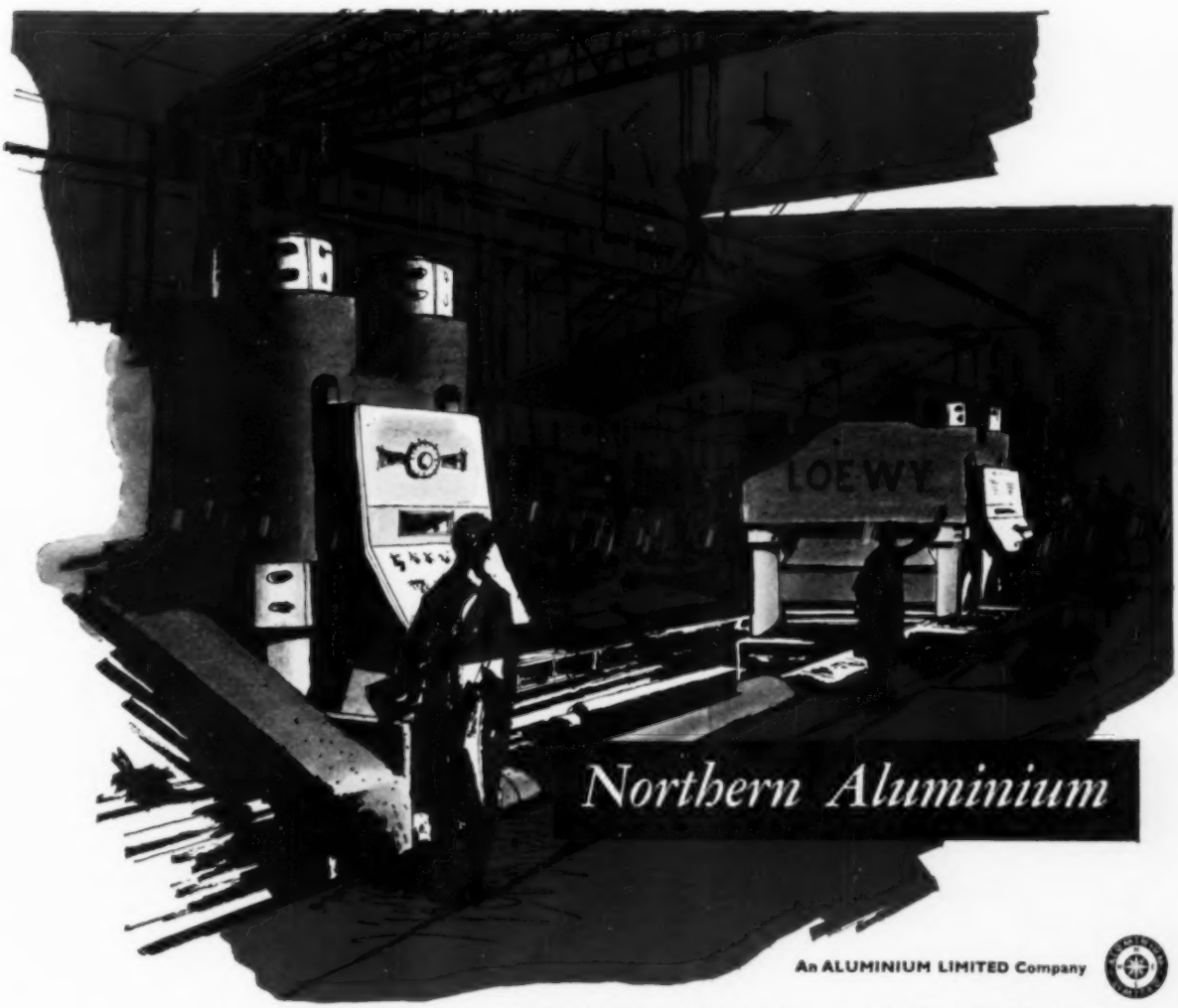
4,000 TON PLATE STRETCHER

widens scope for integral construction

This new plate stretcher now being installed at Northern Aluminium Company's Rogerstone Works is a highly significant piece of equipment. It makes available to British aircraft constructors controlled-stretched, heat-treated, light alloy plate in far larger sizes than before, opening up a new perspective in integral construction.

With a pull of 4,000 tons this machine can stretch a solution-heat-treated plate in any of the strongest available alloys with a cross-sectional area of 200 sq. in. Its limiting capacity for individual dimensions is plate 10 ft. in width, 50 ft. in length, or 6 in. in thickness; typical available sizes of plate in D.T.D. 5010 alloy will be: 1 in. x 6 ft. x 50 ft.; 2 in. x 6 ft. x 25 ft.; and 3 in. x 6 ft. x 16 ft.

If the availability of large *stretched* plates, with their good metallurgical qualities and freedom from distortion under heavy machining interests you, our Sales Development Division at Banbury, Oxon, will be glad to discuss specific problems.



An ALUMINIUM LIMITED Company

NORTHERN ALUMINIUM COMPANY LIMITED, BUSH HOUSE, ALDWYCH, LONDON W.C.2

FLIGHT
18 October 1957

Boosted off the launcher by rockets, Bloodhound is within seconds seeking its target at well over 1,000 mph.

BLOODHOUND ENTRUSTED WITH MAJOR ROLE IN BRITAIN'S AIR DEFENCE

Bristol/Ferranti Bloodhound complete surface-to-air missile system tested, proved and in full production

The widespread redeployment of Britain's armed forces away from manned and towards unmanned weapons, is reflected in Bristol's production lines. Production of the Bloodhound guided weapon system is—with the exception of the Britannia airliner—the largest single activity of the Bristol Group of Companies.

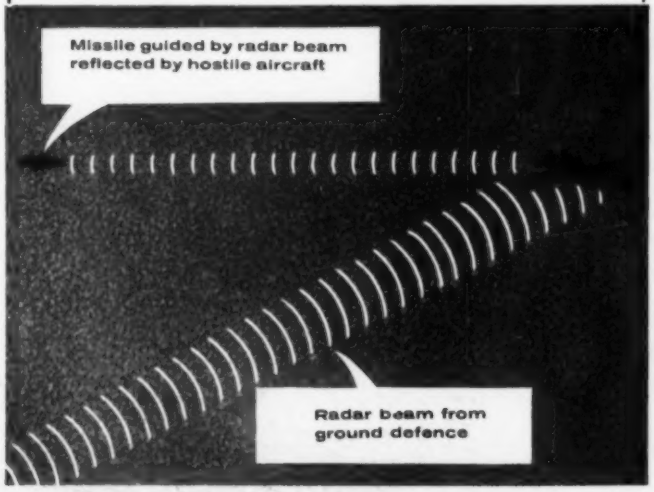
The Bloodhound will become the mainstay of the United Kingdom defence network as surface-to-air missiles progressively take over from the manned fighter. Bloodhounds and their Bristol Thor-type ramjet engines have reached an extremely high stage of development. The system has already proved its effectiveness and is in production for the Royal Air Force.

BRISTOL

Bloodhound

BRISTOL AIRCRAFT LIMITED

OPERATION: Bloodhound, with its Ferranti-designed guidance and control system, is a semi-active homing missile; this means that it is guided by a radar beam projected at the target and reflected back to receiving equipment in the missile itself.

As a hostile aircraft approaches, its position is plotted and followed by radars. Co-ordinates of this position are fed to the missile launchers which move automatically to bear on the target. As soon as the echo from the target indicates, by its strength, that the target is within range, a light flashes in front of the launch controller, who has only to press the firing button to send Bloodhound roaring into the sky.

ELECTRONIC GUIDANCE AND CONTROL BY FERRANTI LTD.